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DETAN 95: Computer Code for Calculating Spectrum-Averaged Cross Sections and Detector Responses in Neutron Spectra

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Abstract

DETAN 95 is a computer code for converting an input neutron spectrum to a spectrum or detector response function expressed in arbitrary energy-group structure. The input spectrum may be expressed either in analytic form or in some energy-group structure. The code also calculates spectrum-averaged neutron cross sections or responses for neutron personnel detectors. The code includes 625-group neutron cross sections for a number of reactions common to materials dosimetry. Other energy-dependent cross sections or response functions supplied by the user may be used to calculated spectrum-averaged values.

I. HISTORY

The computer code for DETector Analysis was written at the Los Alamos Scientific Laboratory for J. Grundl (NIST, retired) while he was at that Laboratory. The primary function of the code is to calculate the integral response of detector foils exposed to an arbitrary energy spectrum of neutrons. The FORTRAN statements which were included in the code at that time can generally be identified by the presence of DETA in columns 73-76 in the current version of the code. After the code was brought to the National Bureau of Standards by Dr. Grundl, it was modified by A. Fabry, a guest worker from the CEN/SCK Laboratory in Mol, Belgium. Dr. Fabry's modifications consisted mainly of adding an eighth option for the input spectrum in order to treat the 1/E spectrum more precisely. Some of the discussion to follow is based on an unpublished description of the DETAN code which he wrote in 1972. The code was further modified by C. Eisenhauer of NBS during 1973 and 1974. The four main modifications which he made were 1) option for reading in from tape the SAND II cross section library; 2) option to calculate response functions for coarse energy groups whose boundaries *do not* necessarily match the boundaries of the fine energy groups; 3) inclusion of a subroutine for converting a lethargy histogram from one group structure to another using a linear-segment approximation or the input lethargy histogram; 4) modification of the option for specification of the input spectrum in multi-group format so that the group structure does not have to coincide with the fine group structure associated with the input cross sections. The version of the code with these modifications included was known as DETAN 74. The option for reading SANDII cross sections is no longer of interest to most users.

II. GENERAL DESCRIPTION OF THE CODE

A. INPUT INFORMATION

Differential-energy cross section data for input to DETAN have to be given in multi-group format. More specifically, $\sigma(E)$ is approximated as a set of group-averaged cross section $\sigma_i (i = 1, \ldots, N)$ for N-consecutive energy groups. These energy groups are specified by N + 1 energy limits, $E_1, \ldots, E_i, \ldots, E_{N+1}$. Group i covers the energy range E_i to E_{i+1} and has an energy width $\Delta E_i = E_{i+1} - E_i$. ENDF/B-V materials dosimetry cross sections tabulated for 625 energy groups (fine groups) are provided with the code.

An option allowing specification of point cross sections in an input file exists in the DETAN code. The option permits the user to specify the energy grid on which fluences and cross sections will be interpolated. A linear interpolation of the input cross section on a log-log scale is performed between input energies. A "1/v" extrapolation of cross sections is permitted for energies below the lowest input energy; a constant extrapolation is permitted for energies above the highest input energy.

The neutron field $\phi(E)$ is either expressed analytically as a function depending on up to 7 input parameters, or given as multi-group fluence spectrum $[\phi(u)\Delta u]_i \equiv [\phi(E)\Delta E]_i$, as obtained for instance from a discrete-ordinates or Monte Carlo transport calculation. In the case of an analytical representation, $\phi(E)$ is evaluated at each mid-energy of the group structure used to specify $\sigma(E)$, e.g., $\phi_i = \phi[E_i + (\Delta E_i)/2]$.

The current version of DETAN, (DETAN 95), incorporates 10 options for the spectral function $\phi(E)$, as follows:

1. *WATT function*

$$\phi(E) = \sqrt{\frac{\beta}{\pi Q}}\; e^{-\beta Q}\, e^{-\beta E} \sinh 2\,\beta\sqrt{QE}$$

with

$$\bar{E} = Q + \frac{1.5}{\beta} \quad .$$

Here the parameter β in units of (MeV) is the inverse of the effective Watt temperature which in turn is 8/9 of the maximum of the distribution of fission-fragment nuclear temperature [1]. The parameter Q in units of MeV is the effective temperature-per-nucleon of the fission fragments.

2. *MAXWELLIAN function*

$$\phi(E) = 1.129\; \beta^{3/2}\, \sqrt{E}\; e^{-\beta E}$$

with

$$\bar{E} = \frac{1.5}{\beta} \quad .$$

Here β is related to the maximum energy of the average of the fission fragment excitation energy.

3. *EVAPORATION function*

$$\phi(E) = \beta^2\, E\, e^{-\beta E}$$

with

$$\bar{E} = \frac{2.0}{\beta} \quad .$$

Here β is the reciprocal of the temperature of the residual nucleus.

4. *MULTIGROUP function*

$$\phi_i(E) = \frac{\Delta\phi_i}{\Delta E_i}$$

with $\Delta\phi_i = \phi_i(u)\,\Delta u_i = \phi_i(E)\,\Delta E_i$, where u is the lethargy variable defined by $u = \ln(E/E_o)$ input for each group and with

$$\bar{E} = \frac{\sum_{i=1}^{N} (E_i + \Delta E_i/2)\,\Delta\phi_i}{\sum_{i=1}^{N} \Delta\phi_i} \quad .$$

For this option, the input spectrum is given in multi-group format.

5. *MAXWELLIAN + EVAPORATION function*

$$\phi(E) = \frac{1}{(1+c) + Q + \frac{Q^2}{4}(1+d)} \left[(1+c)\, 1.129\, \beta^{3/2} \sqrt{E}\, e^{-\beta E} \right.$$

$$\left. + a^2 Q^{2b+1} E\, e^{-aQ^b E} + \frac{8Q^2}{4} E\, e^{-9E} (1+d) \right]$$

with

$$\bar{E} = \frac{\frac{1.5(1+c)}{\beta} + 2\,\frac{Q^{1-b}}{a} + \frac{Q^2}{18}(1+d)}{(1+c) + Q + \frac{Q^2}{4}(1+d)} .$$

Here β and Q have the same meaning as in function types 2 and 3. Other parameters are normalization constants.

6. *POWER LAW function* ($\bar{E} = 0$) (*)

$$\phi(E) = c\, \frac{a/E + b\, E^{\beta}}{a \ln 10^4 + b\, 10^{1+\beta}}$$

7. *MAXWELLIAN + 2 EVAPORATION functions*

$$\phi(E) = \frac{1}{(1+c) + Q + \frac{Q^2}{4}(1+d)} \left[(1+c)\, 1.129\, \beta^{3/2} \sqrt{E}\, e^{-\beta E} \right.$$

$$\left. + a^2 Q^{2b+1} E\, e^{-aQ^b E} + \frac{(1+d)Q^2}{4} \left[\frac{9+a/Q^b}{1+e} \right]^2 E \exp - \left[\frac{9-a/Q^{\beta}}{1+e} E \right] \right]$$

with $\bar{E} = 1$ assumed for simplicity.

8. *1/E SPECTRUM* ($\bar{E} = 0$)

$$\phi(E) = \frac{1}{E}$$

(*)Special-case: if $b = \beta = 0$, $a \neq 0$ arbitrary, one obtains a 1/E shape $\phi(E) = \dfrac{c}{E \ln 10^4}$.

The resonance integral $\left[I = \int \sigma(E) \frac{dE}{E} \right]$ can be computed exactly from $I = \sum_{i=1}^{N} \sigma_i (\Delta\phi)_i$ for a 1/E spectrum, $(\Delta\phi)_i = (\Delta u)_i$. Therefore, $I = \sum_{i=1}^{N} \sigma_i (\Delta u)_i = \phi \bar{\sigma}$, where $\phi = \sum_{i=1}^{N} (\Delta u)_i$, and the lowest energy boundary of group 1 corresponds to the cadmium cut-off energy.

9. *MAXWELLIAN + CORRECTION*

The correction function can be specified as n discontinuous corrections

$$C_i(E) = 1 + A_i \qquad \text{(NORDER = 0)}$$

or more commonly, as a set of n piecewise-continuous linear functions of the form

$$C_i(E) = 1.0 + A_i + B_i E \ ,$$

for energies below E_0, and an exponential function above E_0:

$$C_i(E) = (1.0 + A_i + B_i E_0) \exp \left\{ \frac{B_i(E-E_0)}{(1.0 + A_i + B_i E_0)} \right\} \ .$$

This is in the form in which the NBS fission spectrum evaluation is given.

10. *HIGH-ENERGY FISSION TAIL*

This option allows a (Maxwellian + Correction) shape of the above form to be added above an energy bound near the high-energy end of an input multigroup spectrum.

B. OUTPUT INFORMATION

The cross section or response averaged over the selected neutron field is simply

$$\bar{\sigma} = \sum_{i=1}^{N} \frac{\sigma_i (\Delta\phi)_i}{\phi}$$

with

$$\phi = \sum_{i=1}^{N} (\Delta\phi)_i = \text{total fluence} \ .$$

The code also provides the following quantities for each fine group (and each coarse group):

1. the fluence per unit energy interval $\phi_i(E)$ (fine groups) or the group fluence $(\Delta\phi)_i$ (coarse groups)
2. the group lethargy width $(\Delta u)_i = |\ln (E_i/E_{i+1})|$

3. 'luence per unit lethargy interval

$$\phi_i(u) = \frac{(\Delta\phi)_i}{(\Delta u)_i}$$

4. the normalized dosimetry or response function

$$D_i = \frac{\sigma_i\,(\Delta\phi)_i}{\sum_{i'=1}^{N} \sigma_{i'}\,(\Delta\phi)_{i'}}$$

5. the cumulative normalized response function

$$C_i = \frac{\sum_{i'=1}^{i} \sigma_{i'}\,(\Delta\phi)_{i'}}{\sum_{i'=1}^{N} \sigma_{i'}\,(\Delta\phi)_{i'}}$$

6. the group-averaged cross section for each coarse group

$$\bar{\sigma}_i = \frac{\sum_{j=i_1}^{i_2} \sigma_j\,\omega_j\,(\Delta\phi)_{ij}}{\sum_{j=i_1}^{i_2} \omega_j\,(\Delta\phi)_{ij}}$$

with $\Delta\phi_{ij}$ being the fluence in each fine group j which is included in the coarse group i, and ω_j being the fine group weight associated with linear-segment weighting. Quantities 1 and 3 above, i.e., the fluence output, can be either tabulated in the absolute intensity scale of the input spectrum or normalized to unit total fluence $\phi = 1$. Normalization is done by setting the input parameter NORM equal to 1.

C. COARSE GROUP INFORMATION

The code contains an option to collapse the input fine-group cross section set into a coarser group structure of NG energy groups specified by NE = NG + 1 energy boundaries ε_1, ..., ε_g, ..., ε_{NE}. Group G covers the energy range ε_g to ε_{g+1} and has an energy width $\Delta\varepsilon_g = \varepsilon_{g+1} - \varepsilon_g$. The collapsing procedure converts the fine-group lethargy histograms into coarse-group lethargy histograms. The dosimetry or response function for the ith coarse group is given by

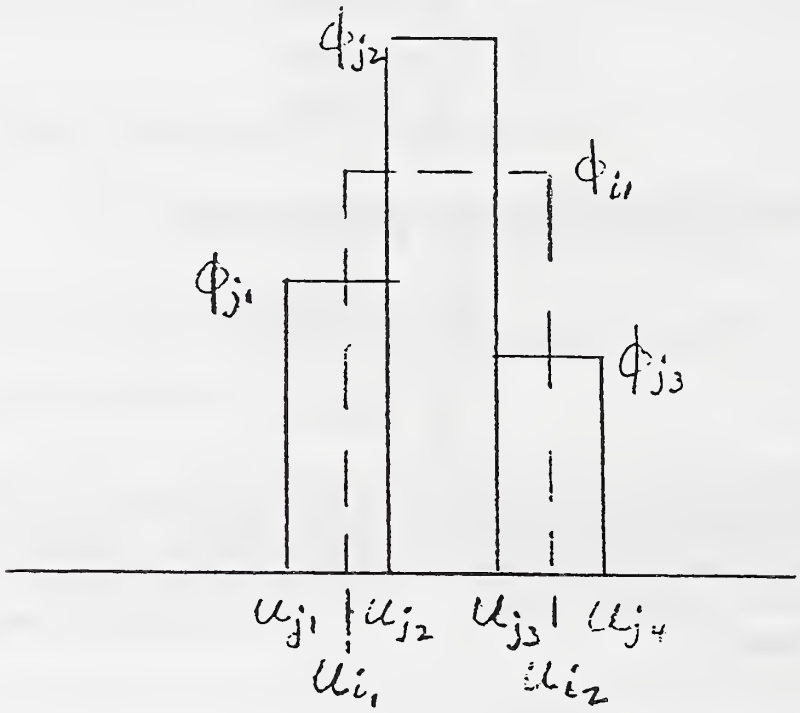
$$R_i = \sum_{j=j_i}^{j_{i+1}} \phi_{ji}(u)\,\sigma_j(u)\,\Delta u_j$$

and the fluence is given by

$$\phi_i = \sum_{j=j_i}^{j_{i+1}} \phi_{ji}(u)\,\Delta u_j$$

for all groups j contained within the coarse group i. When the group boundaries do not coincide, a fraction of the fine group is assigned to the coarse group. For example, for a coarse group g spanning three fine groups, the fluence in the coarse histogram would be obtained from the fluences in the fine ones by equating the area of the coarse group to the total area of the fine groups lying between the two coarse energy boundaries:

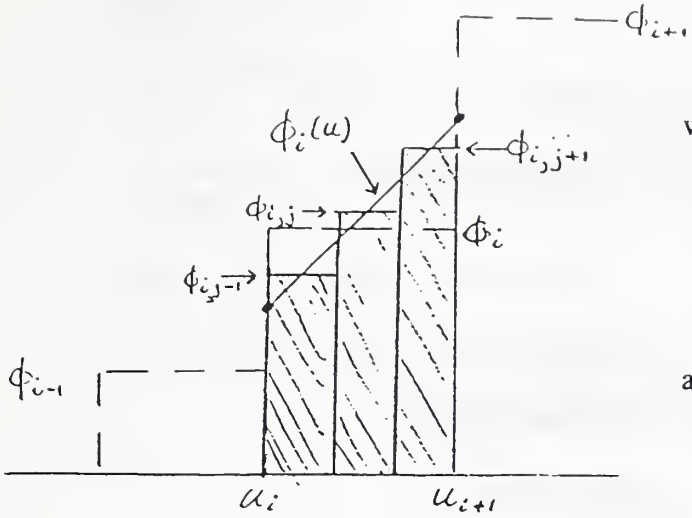
$$\phi_{i1}(u_{j3}-u_{j2}) = \phi_{j1}(u_{j2}-u_{i1}) + \phi_{j2}(u_{j3}-u_{j2}) + \phi_{j3}(u_{i2}-u_{j3})$$



It is also possible-to approximate the fine-group histogram by linear segments before collapsing to the coarse group structure. This can be done by changing an input parameter to the CONVRT subroutine.

CONVRT Subroutine

When the input spectrum is specified in a multigroup structure: (IF = 4, on the first input data card), the input spectrum must be converted to a fine-group spectrum in order to be weighted with fine-group cross sections. This is done in the CONVRT subroutine by replacing the input lethargy histogram with a series of linear segments. The slope of each segment is determined by the fluence in the two neighboring energy groups, while the absolute value is determined by the area of the histogram:



$$\phi_i(u) = m_i\, u + b_i$$

where

$$m_i = \frac{(\phi_{i+1} - \phi_{i-1})}{2(u_{i+1} - u_i)}$$

and b_i is obtained from:

$$\phi_i\,(u_{i+1} - u_i) = \int_{u_i}^{u_{i+1}} (m_i\, u + b_i)\, du \quad .$$

The average cross section is calculated from

$$\bar{\sigma} = \frac{\Sigma_j\, \Sigma_i\, [\phi(u)\Delta u]_{ij}\sigma_i(E)}{\Sigma_j\, \Sigma_i\, [\phi(u)\Delta u]_{ij}} \qquad \text{(linear lethargy segments)}$$

where

$$[\phi(u)\Delta u]_{ij} \equiv \int_{u_i}^{u_{i+1}} \phi_j(u)\, du$$

The current version of CONVRT converts the lowest energy group of the input spectrum into a constant in lethargy (i.e., 1/E spectrum). The user may prefer that the spectrum in the lowest energy group be assumed to be linear behavior which decreases as lethargy increases (i.e., as energy decreases). This may be accomplished by replacing the present 73rd instruction in the FORTRAN listing of the CONVRT subroutine (IF (K.EQ.1) XM = 0.0 with IF (K.EQ.1) M = −0.5* F1(K+1)/DELU1(K+1)/DELU1(K)]: Note that the DETAN code has no provision for converting the lowest energy group to such realistic shapes as a thermal Maxwellian, or a cadmium cut-off function. Therefore, DETAN should not be used to calculate responses for situations where a significant fraction of the response lies below 1 eV.

III. INPUT DATA

File 1: Parameter File

Card Image 1 (4I6, 2E12.6, 2I6, E12.6)

– IF : Option for spectral function (see Section II A)
= 1 WATT
= 2 MAXWELLIAN
= 3 EVAPORATION
= 4 MULTIGROUP
= 5 MAXWELLIAN + EVAPORATION
= 6 POWER LAW
= 7 MAXWELLIAN + 2 EVAPORATIONS
= 8 1/E SPECTRUM
= 9 MAXWELLIAN + CORRECTION
= 10 OPTION 10

– NO : 0 no collapsing
> 0 collapsing in NG coarse groups

– NPLOT : = 0 No plot data requested
= 1 generates a spectrum file for later input to DETAN
= 2 option removed from code
= 3 calculates $\log[\phi(E)/\sqrt{E}]$

– NPU : Punch option
(Obsolete parameter) Set equal to zero.

– BETA : Spectral parameter β
For IF = 0 or 10, BETA is set equal to coefficient in reference MAXWELLIAN (BETA = 0.7614 for U-235 and BETA = 0.7042 for Cf-252).

– Q : Spectral parameter Q

– NORM : Normalization option
$\neq$ 1 : no normalization
= 1 : all fluences normalized to $\phi = 1$ before printing

– NPR $\neq$ 0 : Print fluence and response functions for the fine groups
= 0 : No printout of fine-group information

– PINPUT = Percentile energy at which truncated cross sections are calculated:

$$\bar{\sigma} = \int_{E_p}^{\infty} \sigma(E)\,\phi(E)\,dE \Big/ \int_{E_p}^{\infty} \phi(E)\,dE$$

Card Image 2 (5E12.6)

– VAPA, VAPB, VAPC, VAPD, VAPE: Spectral parameters a,b,c,d,e,

File 2: Energy File

Card Image 1 (I6)
– NE : Number of coarse group energy limits for output spectrum (= NG + 1)

Card Image 2 (6E12.6)
– G(M) m = 1, ..., NE energy limits for subintegration.

File 3: Cross Section or Response File

Card Image 1 (I8, 11A6)

IC : < 0 : Read a new File 1 aimed at using in a second (or third, ...) run another spectral shape with the same σ_i and the same integration groups g.

≥ 0 : Specify cross sections σ_i for the first detector or for another detector. HOWEVER, in the latter case the spectral function remains unchanged.

– ID : Run termination index or identification of cross section on tape
- Columns 9-16: ID number of cross section (left-adjusted)
- Columns 9-12: blank: terminate run

Further Card Images needed at this point only if IC ≥ 0:

Card Image 2 (5I6)
– N : Number of energy groups in which σ_i is specified -

– NR : Determines the input format for E_i (card image 4, below) -

– NS : Determines the input format for σi (card image 7, below)

– NT : Number of pseudo-tape unit on which ENDF/B-V cross sections are tabulated. The filenames for standard dosimetry sections is endfbv. If other dosimetry cross sections or response functions are used as input, NT = 0.

– NPT : ≤ 0 : Code will interpret input cross sections as group cross sections in the usual way.

> 0 : Code will expect point cross sections.

Sequence for usual group-averaged cross sections (NT ≠ 0) from ENDFV file

Card Image 3 (I10)
– NET Number of energy boundaries for fine group cross section tabulation

Card Image 4 (8E10.3)
– E_i : i = 1, ..., NET Fine-group energy boundaries

Card Image 5 (18A4)
– IB Eight-character identifier for dosimetry nuclide, followed by arbitrary comment

Card Image 6 (8E10.3)
– DUM Obsolete dummy record

Card Image 7 (8E10.3)
– SIGMA(I) Fine-group cross sections

Sequence for other group-averaged cross section set (NT ≠ 0, NPT = 0)

Card Image 3 (6E12.0) (NR ≠ 0)
(12E6.0) (NR = 0)

– E_i , i = 1, ... NET, NK Fine-group energy boundaries, increasing energy order
– E_{NK} : Energy shift allowing a check of the sensitivity to an energy shift (normally blank).

Card Image 4 (6E12.0) (NR ≠ 0)
(12E6.0) (NR = 0)

– SIGMA(I) Fine-group cross sections or responses

Sequence for point cross sections. (NT = 0 , NPT > 0)

Card Image 3 (2I6)
– NEXH : Extrapolation index for high energies.

≤ 0 : Cross sections are set equal to zero at energies above the highest input energy.

> 0 : Cross sections at energies above the highest input energy are set equal to the value of the cross section at the highest input energy.

– NEXL : Extrapolation index for low energies.

≤ 0 : Cross sections are set equal to zero below the lowest input energy (card 6c).

> 0 : Cross sections at energies E below the lowest input energy are set equal to $\sigma_0\sqrt{E_0/E}$ where E_0 is the lowest input energy and σ_0 is the cross section at that energy.

Card Image 4 (18A4)
– FORM : Input format for energies and cross sections (e.g., (6E12.6)).

Card Image 5 FORM
– (F(I), I = 1, N) : Energies, in order of increasing energy, at which input cross sections are tabulated.

Card Image 6 FORM
– (SIG (I), I = 1, N) : Cross sections at these energies

Card Image 7 (6E12.6) (Used only for point cross sections, NPT > 0)
(File 3a)
– (E(I), E = 1, N+1) : List of energy boundaries of fine groups. *INCREASING ENERGY ORDER*, MeV. Fluences and cross sections are interpolated at the average energy of each group.

(At NIST, file 3a, consisting of 625 energy boundaries, including those for the 620-group SAND II data, are being used. These are the same energies as used in the DETAN endfbv.d cross section file.)

File 4: Input spectrum File

A. Input options, IF = 4 or 10

Card Image 1 (4A4, 10A4, 2A4, 2A4)
– DESIG short title for spectrum
– TITLE more detailed information
– DATE date spectrum file created
– REV date spectrum file revised

Card Image 1a (6E12.6) only if IF = 10

– ELIMIT : Energy above which fission shape will be assumed.

– OPT10 : Normalization parameter. Set equal to the ratio of the number of neutrons in the multigroup input spectrum above some arbitrary energy E_0, to that in the fission spectrum above the same energy. The latter can be obtained from preliminary run with option 9.

Card Image 2 (I8) only if IF = 4 or 10
– NUM : Number of groups for input spectrum.

Card Image 3 (6E12.0) only if IF = 4 or 10.
– ENUM(I) : Energies in MeV, in INCREASING ENERGY ORDER.

Card Image 4 (6E12.6)
– $(\Delta\phi)_i$ Group fluence

FNUM(I) :
Card Image 5 (4A4, 10A4, 2A4, 2A4) (only if IF = 10)
Information on fission shape being added to tabulated spectrum.

Further Card Images: (Follow input option 9)

B. Input option 9

Card Image 1 (2I6)
– NORDER : Order of correction function;
NORDER ≤ 0 for discontinuous constant adjustments
NORDER > 0 for continuous linear segment adjustments

– NUM : Number of energy intervals for which corrections are specified.

Card Image 2 (6E12.6)
– ENUM(I) : Energy boundaries (increasing energy order, (NUM + 1) entries).

Card Image 3 (6E12.6)
– (FNUM(I)I + 1, NUM) : Values of the parameter A in the form C(E) = 1 + A + BE.

Card Image 4 (6E12.6) if NORDER > 0
– (FNUM(I), I = (NUM + 1), 2 * NUM) : Values of the parameter B in the same form.

File 5 Termination or Restart File

Card Image 1 Blank card if job terminated.
If ID is not blank on Card Image 1, one has to give a new set of cards for the next run.

IV. DESCRIPTION OF CROSS SECTION FILE endfbv.d

The file endfbv.d supplied with the DETAN program contains ENDF/BV dosimetry cross sections which are now in use at several laboratories. The user is cautioned: The cross sections do *not necessarily represent current recommended values*.

The cross section data in the file are stored in the following format:

Data	*Format*
Number of energy bounds (621)	(I10)
Energy list (increasing order, MeV)	(1P8E10.3)
Short name, long name; first reaction	(20A4)
Dummy parameter	(E10.3)
Cross sections; first reaction	(1P8E10.4)
. .	
. .	
. .	
Short name, long name; 38th reaction	(20A4)
Dummy parameter	(E10.3)
Cross sections; 38th reaction	(1P8E10.4)

The following is a list of the cross sections on file endfbv.d. The suffix "5" on the ID number indicates group-averaged ENDF/B-V data.

File:endfv.rr

2SQRTE	RECP VEL 1/V	ENDF/BVC DOSIMETRY FILE
3PU239F5	PU239(N,F)FP	ENDF/BVC DOSIMETRY FILE
4U235F5	U235(N,F)FP	ENDF/BVC DOSIMETRY FILE
5U233F5	U233(N,F)FP	ENDF/BVC DOSIMETRY FILE
7NP237F5	NP237(N,F)F.P.	ENDF/BVC DOSIMETRY FILE
6U238F5	U238(N,F)FP	ENDF/BVC DOSIMETRY FILE
8TH232F5	TH232(N,F)F.P.	ENDF/BVC DOSIMETRY FILE
9PU24OF5	PU240(N,F)FP	ENDF/BVC DOSIMETRY FILE
10PU24lF5	PU241(N,F)FP	ENDF/BVC DOSIMETRY FILE
11AM24lF5	AM241(N,F)FP	ENDF/BVC DOSIMETRY FILE
12U238G5	U238(N,G)U239	ENDF/BVC DOSIMETRY FILE
13TH232G5	TH232(N,G)TH233	ENDF/BVC DOSIMETRY FILE
14NA23G5	NA23(N,G)NA24	ENDF/BVC DOSIMETRY FILE
15SC45G5	SC45(N,G)SC46	ENDF/BVC DOSIMETRY FILE
16FE58G5	FE58(N,G)FE59M	ENDF/BVC DOSIMETRY FILE
17CO59G5	C059(N,G)C060	ENDF/BVC DOSIMETRY FILE
18CU63G5	CU63(N,G)CU64	ENDF/BVC DOSIMETRY FILE
19IN115G5	IN115(N,G)IN116M	ENDF/BVC DOSIMETRY FILE
2OAU197G5	AU197(N,G)AU198	ENDF/BVC DOSIMETRY FILE
21BlOA5	B10(N,A)LI7	ENDF/BVC DOSIMETRY FILE
22LI6A5	LI6(N,A)H3	ENDF/BVC DOSIMETRY FILE
24IN115N5	IN115(N,N)IN115M	ENDF/BVC DOSIMETRY FILE
25TI47P5	TI47(N,P)SC47	ENDF/BVC DOSIMETRY FILE
26S32P5	S32(N,P)P32	ENDF/BVC DOSIMETRY FILE
27NI58P5	NI58(N,P)C058	ENDF/BVC DOSIMETRY FILE
28FE54P5	FE54(N,P)MN54	ENDF/BVC DOSIMETRY FILE
29TI46P5	TI46(N,P)SC46	ENDF/BVC DOSIMETRY FILE
3OAL27P5	AL27(N,P)MG27	ENDF/BVC DOSIMETRY FILE
31NI60P5	NI60(N,P)C060	ENDF/BVC DOSIMETRY FILE
32FE56P5	FE56(N,P)MN56	ENDF/BVC DOSIMETRY FILE
33CU63A5	CU63(N,A)C059	ENDF/BVC DOSIMETRY FILE
34AL27A5	AL27(N,A)NA24	ENDF/BVC DOSIMETRY FILE
35TI48P5	TI48(N,P)SC48	ENDF/BVC DOSIMETRY FILE
36MN5525	MN55(N,2N)MN54	ENDF/BVC DOSIMETRY FILE
37RH103NP	RH(N,N')	PAULSEN, ET AL NSE 76 331 (1980) 7-7-86
38NB93NNP	NB(N,N')93M NB	FROM DRAFT AERE-R 12612 6-10-87
45DPA-REV	DPA(E-693)	ASTM 9-28-87

The DETAN 95 program includes a group of additional comment cards which can be used to read the original SAND II library tape from which the format for the endfbv.d cross section file was generated. The dummy parameter above has been included to make the format compatible with the SAND II tape.

V. OUTPUT DATA

IC,ID : Identification of first detector called for in the program (only if NT = 0).

JS, IB : Number and identification of detectors read in from tape (only if NT > 0).

N, NR, NS, NT, NPT: Parameters for cross section tabulation (only if NT = 0 or IREP = 0).

E(I), SIGMA(I): Energy bins and group averaged cross section when not from file endfbv.d (only if NT = 0 and NPT = 0).

NEXH, NEXL: Parameters for point cross section tabulation

FORM: (only if NT = 0 and NPT > 0).

F(I), SIG(I):

DESIG, TITLE, DATE (only if IF = 4).

ENUM(I), ENUM(I + 1), FNUM(I), SUM, SUME: Lower and upper energies of each group, Multi-group fluence, cumulative fluence, cumulative (fluence times average energy) (only if IF = 4).

EAV : Average energy of input spectrum (only if IF = 4).

RNA : Unnormalized total input fluence.

ELIMIT, OPT10: Information for IF = 10 input (only if IF = 10).

The following fine-group information is printed out only if NPR $\neq$ 0:

ID Detector identification

Run identification

BETA, EAV, SI, IF, RNA: Value of beta in exponent of input spectrum, average energy of input spectrum, average cross section for detector, type of input spectrum, unnormalized total input fluence (only if IF = 5, 6, or 7).

Q, BETA, IF, RNA: Q-parameter of input spectrum; Other parameters same meaning as above (only if IF > 4)

VAPA, VAPB, YAPC, YAPD, YAPE: Parameters a, b, c, d, and e of input spectrum (only if IF > 4)

EAV, SI: Same meaning as above (only if IF > 4)

Indication of normalization (only if NORM = 1)

I, E(I), DELTAE(I), DULTAU(I), U(I), FN(I), SIGMA(I), RN(I), Y(I), F(I + 1) fine-group number, energy (MeV), energy interval of group, fluence per unit lethargy interval $\frac{\Delta E}{\Delta u}$ F(E), fluence per unit energy interval (F(E)), input cross section for group, response for group (σ(E) F(E) ΔE), response cumulated from low-energy end, upper energy of group.

(End of fine-group printout)

The following information is printed only if N0 = 0:

DESIG, TITLE, DATE: Information about spectrum and entry date
(G(M - 1), SUMFN(M), CUMSRN(M), G(M + NX - 1), SUMRN(M + NX), CUMSRN(M + NX), m = 2, NX - 1) tabulation of energy boundary, relative group fluence, and cumulation fluence

RNA total fluence

TITLE, DESIG

ID(I) Information about spectrum and entry date

FGTI, REV

ID(3), ID(4), ID(5), SI, TRUNC, FRAC, E50, E95, E05
Cross section designation, total cross section, Cross section truncated at E_{95}, fraction of fluence above E_{95}, and energies above which 50%, 95%, and 5% of the response occurs.

This information is repeated for all the reactions in the endfv.rr file.

The following information is printed only if NO $\neq$ 0:

ID Detector identification

Run identification

Q, BETA, IF: Q-parameter of input spectrum, value of beta in exponent of input spectrum, type of input spectrum (only if IF = 5, 6, or 7).

VAPA, VAPB, VAPC, VAPD, VAPE: Parameters a, b, c, d, and e of input spectrum (only if IF = 5, 6, or 7).

EAV, SI: Same meaning as above (only if IF = 5, 6, or 7).

Indication of normalization (only if NORM = 1)

BETA, EAV, SI, IF, RNA: Value of beta in exponent of input spectrum, average energy of input spectrum, average cross section for detector, type of input spectrum, unnormalized total input fluence (only if IF ≠ 5, 6, or 7).

TRUNC, PP, FRAC, E50, E95, E05 Spectrum Parameters

MD, G(M-1), G(M), U(M), DULTAU(M), SUMFN(M), SUMRN(M), CUMSRN(M), SIGMP(M): coarse group number, lower and higher energy boundaries of group, fluence per unit lethargy interval, lethargy interval of group, group fluence, response for group, response cumulated from high-energy end, average cross section for group.

"Plot message", actually stores spectrum in format for input to DETAN (only if NPLOT = 1)

DESIG, TITLE, REV

NEP

(G(M), M = 1, NE) (only if NPLOT = 1)

(SUMRN(M), M = 2, NE)

VI. SAMPLE PROBLEMS

A. INPUT SCRIPT

The unicos script for executing DETAN95 with parameter IF = 4 is shown in Appendix A. Other input spectrum options can be activated by adding # signs to the Type 4-option and removing them for the desired option.

B. SAMPLE OUTPUT PROBLEMS (See Appendix B)

1. IF = 9 NO = 1, NPLOT = 0: NBS-evaluated Cf spectrum, fluence spectrum and ^{235}U response spectrum printouts.

2. IF = 9 NO = 1, NPLOT = 1: NBS-evaluated Cf spectrum, spectrum printout, DETAN input file generated.

3. IF = 4, NO = 1: Group spectrum generated from sample problem 1. Note, ^{235}U cross section is 1.23583 for both problem 1 and 3, indicating that DETAN reproduces original spectrum very well.

4. IF = 9 NO = 0: NBS-evaluated Cf spectrum, detector-listing output.

5. IF = 4 NO = 0: NBS-evaluated Cf group-spectrum input and detector-listing output.

6. IF = 4 NO = 0: ENDF/BVI-evaluated Cf spectrum. Note good agreement with cross sections from NBS-evaluated Cf spectrum.

7. IF = 2, NO = 0: Analytic Maxwellian approximation to Cf approximation.

8. IF = 1, NO = 0: Watt-Spectrum approximation to ^{235}U fission-neutron spectrum.

VII. ACKNOWLEDGMENTS

The author wishes to acknowledge extensive work on early versions of the DETAN code by Dr. A. Fabry of CEN/SCK, Mol, Belgium and Dr. J. Grundl of NIST (retired); and help at other times from Dr. Mike Weinert, Dr. Mimi Nguyen, Mr. Jeff Lehrman, Mr. Steve McWilliams, and Mrs. Gloria Wiersma.

VIII. REFERENCES

[1] D.G. Madland and J.R. Nix, "New Calculation of Prompt Fission Neutron Spectra and Average Prompt Neutron Multiplicities," *Nucl. Sci. Eng.* **81**, 213-271 (1982).

APPENDIX A

SAMPLE SCRIPT FOR RUNNING DETAN ON UNICOS

```
#   Necessary for proper interpretation of >! (6-20-94)
cd $DETAN

rm -f RESPONS

#########################
# Compilation Commands #
# (use qsub -lM 4mw)   #
#########################
#rm -r bin/detan

#cft77 src/detan85.f ; mv detan85.o obj
#segldr obj/detan85.o -o bin/detan

#########################
# Type 4 Input Stream #
#########################
cat >! inputfile << EOF
     4     1     0     0 .7042                        1     0 0.95

EOF

cat lib/48.e lib/const.rr  lib/ivans.s >> inputfile
#cat lib/endfv.rr >> inputfile

cat >> inputfile << EOF

EOF
#      27NI58P5  NI58(N,P)CO58        ENDF/BVC DOSIMETRY FILE

#########################
# Type 9 Input Stream #
#########################
#cat >! inputfile << EOF
#     9     0     0    0 .7042                        1     0 0.95

#EOF

#cat lib/46.e lib/const.rr lib/xcf.s >> inputfile
#cat lib/endfv.rr >> inputfile

#cat >> inputfile << EOF

#EOF

#########################
# Type 1 Input Stream #
#########################
#cat >! inputfile << EOF
#     1     0     0     0 1.012        0.549          1     0 0.95

#EOF

#cat lib/45.e lib/const.rr lib/xu5en6.s >> inputfile
#cat lib/endfv.rr >> inputfile

#cat >> inputfile << EOF

#EOF

##########################
#   Type 2 Input Stream #
##########################
#cat >! inputfile << EOF
#     2     0     0    0 .7042                        1     0 0.95
```

```
#EOF

#cat lib/45.e lib/const.rr lib/xcfmax.s >> inputfile
#cat lib/endfv.rr >> inputfile

#cat >> inputfile << EOF

#EOF

#######################
# Type 3 Input Stream #
#######################
#cat >! inputfile << EOF
#     3     0     0     0 1.0                          1     0 0.95

#EOF

#cat lib/45.e lib/const.rr lib/xu5en6.s >> inputfile
#cat lib/endfv.rr >> inputfile

#cat >> inputfile << EOF

#EOF

#######################
# Type 8 Input Stream #
#######################
#cat >! inputfile << EOF
#     8     1     0    0 .7614                      1     0 0.95

#EOF

#cat lib/95.e lib/const.rr >> inputfile

#cat >> inputfile << EOF
# 1/E SPECTRUM         RESONANCE INTEGRALS                 5-14-86
#      20AU197G5 AU197(N,G)AU198      ENDF/BVC DOSIMETRY FILE

#EOF

#########################
# Type 10 Input Stream #
#######################
#cat >! inputfile << EOF
#    10     0     0    0 .7042                      1     0 0.95

#EOF

#cat lib/45.e lib/const.rr >> inputfile

#cat >> inputfile << EOF
#ho4625          h2o sphere WITH F SP TAIL > 3.0 MEV   7-07-94
# 3.0119       .0008582
#EOF

#cat lib/ho4625.s lib/xcf.s >> inputfile

#cat lib/endfv.rr >> inputfile
#cat >> inputfile << EOF

#EOF


assign -a lib/endfbv.d u:7

bin/detan < inputfile | asa > output/outputfile
```

```
#########################
#   Printing Option     #
#########################
#lpr -P b225 output/outputfile

cat output/outputfile

rm -f inputfile output/outputfile
```

APPENDIX B

OUTPUTS FROM SAMPLE PROBLEMS

Sample Output from Problem 1

```
Fri Dec  9 13:16:11 EST 1994
You are in the UNICOS C-shell.


-  -  -  -  -  -  Cray Y-MP4E/232 (UNICOS 8.0.2.4)  -  -  -  -  -  -

PROBLEM SIGNING ON?  The Central Computing Facility maintains a
  recorded status message (301-975-6560).  It's helpful to check that
  message if you experience problems signing on to one of the central
  computers.  If you prefer to speak with a person, especially after
  regular working hours, the console operator telephone is 301-975-2967.

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.037s,  Wallclock: 0.067s,  27.6% of 2-CPU Machine
 HWM mem: 203680, HWM stack: 26061, Stack overflows: 0
      1CONST
    1     5

.100000E-070.250000E+000.800000E+000.150000E+010.600000E+010.200000E+02


.237000E+000.980000E-01-.332000E-010.370000E-020.180000E+00

.120000E+01-.140000E+000.240000E-01-.620000E-03-.300000E-01

.704200E+00

.213008E+01
```

CONST
XCF-5-N1 NBS EVALUATED CF FISSION SPECTRUM 5-24-83

BETA= 7.0420000E-01 EAV= 2.1194E+00 AVSIGMA= 1.00000E+00 SPECFN= 9 TOTAL FLUX= 9.99706E-01
TRUNCATED CROSS SECTION = 1.00000E+00 FOR 95. PERCENTILE, FLUX FRACTION =9.500E-01

ALL FLUXES NORMALIZED TO TOTAL FLUX = 1

MEDIAN ENERGY = 1.678E+00 95 PERCENTILE ENG = 2.598E-01 05 PERCENTILE ENG = 5.498E+00

GRP	ELOW	EHI	PHI(U)	DELTA-U	FLUX	RESPONSE	CUM RESP	AVSIG
1	4.1400E-07	8.7640E-07	2.5076E-10	7.4996E-01	1.8806E-10	1.8806E-10	9.9999E-01	1.0000E+00
2	8.7640E-07	1.8550E-06	7.7326E-10	7.4982E-01	5.7980E-10	5.7980E-10	9.9999E-01	1.0000E+00
3	1.8550E-06	5.0430E-06	2.9874E-09	1.0001E+00	2.9877E-09	2.9877E-09	9.9999E-01	1.0000E+00
4	5.0430E-06	1.0680E-05	1.0674E-08	7.5037E-01	8.0093E-09	8.0093E-09	9.9999E-01	1.0000E+00
5	1.0680E-05	3.7270E-05	5.2364E-08	1.2498E+00	6.5446E-08	6.5446E-08	9.9999E-01	1.0000E+00
6	3.7270E-05	1.0130E-04	2.6905E-07	9.9990E-01	2.6902E-07	2.6902E-07	9.9999E-01	1.0000E+00
7	1.0130E-04	2.1440E-04	9.6055E-07	7.4976E-01	7.2018E-07	7.2018E-07	9.9999E-01	1.0000E+00
8	2.1440E-04	4.4500E-04	2.9071E-06	7.3023E-01	2.1228E-06	2.1228E-06	9.9999E-01	1.0000E+00
9	4.4500E-04	1.5850E-03	1.4377E-05	1.2703E+00	1.8262E-05	1.8262E-05	9.9999E-01	1.0000E+00
10	1.5850E-03	3.3550E-03	5.9584E-05	7.4987E-01	4.4680E-05	4.4680E-05	9.9997E-01	1.0000E+00
11	3.3550E-03	7.1020E-03	1.8387E-04	7.4992E-01	1.3789E-04	1.3789E-04	9.9993E-01	1.0000E+00
12	7.1020E-03	1.5030E-02	5.6885E-04	7.4967E-01	4.2645E-04	4.2645E-04	9.9979E-01	1.0000E+00
13	1.5030E-02	2.1880E-02	1.2805E-03	3.7552E-01	4.8085E-04	4.8085E-04	9.9936E-01	1.0000E+00
14	2.1880E-02	2.4180E-02	1.8160E-03	9.9953E-02	1.8152E-04	1.8152E-04	9.9888E-01	1.0000E+00
15	2.4180E-02	2.6060E-02	2.0786E-03	7.4876E-02	1.5564E-04	1.5564E-04	9.9870E-01	1.0000E+00
16	2.6060E-02	3.1830E-02	2.5564E-03	2.0001E-01	5.1130E-04	5.1130E-04	9.9855E-01	1.0000E+00
17	3.1830E-02	4.0870E-02	3.6242E-03	2.4999E-01	9.0599E-04	9.0599E-04	9.9803E-01	1.0000E+00
18	4.0870E-02	6.7380E-02	6.5488E-03	4.9995E-01	3.2741E-03	3.2741E-03	9.9713E-01	1.0000E+00
19	6.7380E-02	1.1110E-01	1.4217E-02	5.0008E-01	7.1095E-03	7.1095E-03	9.9385E-01	1.0000E+00
20	1.1110E-01	1.8320E-01	3.1237E-02	5.0015E-01	1.5623E-02	1.5623E-02	9.8675E-01	1.0000E+00
21	1.8320E-01	2.9720E-01	6.7407E-02	4.8383E-01	3.2613E-02	3.2613E-02	9.7112E-01	1.0000E+00
22	2.9720E-01	3.6880E-01	1.0624E-01	2.1585E-01	2.2932E-02	2.2932E-02	9.3851E-01	1.0000E+00
23	3.6880E-01	4.9790E-01	1.4410E-01	3.0014E-01	4.3251E-02	4.3251E-02	9.1558E-01	1.0000E+00
24	4.9790E-01	6.0810E-01	1.8912E-01	1.9994E-01	3.7813E-02	3.7813E-02	8.7233E-01	1.0000E+00
25	6.0810E-01	7.4270E-01	2.3021E-01	1.9995E-01	4.6032E-02	4.6032E-02	8.3451E-01	1.0000E+00
26	7.4270E-01	8.2080E-01	2.6280E-01	9.9987E-02	2.6277E-02	2.6277E-02	7.8848E-01	1.0000E+00
27	8.2080E-01	1.0030E+00	3.0088E-01	2.0047E-01	6.0317E-02	6.0317E-02	7.6220E-01	1.0000E+00
28	1.0030E+00	1.3530E+00	3.6756E-01	2.9933E-01	1.1002E-01	1.1002E-01	7.0189E-01	1.0000E+00
29	1.3530E+00	1.6530E+00	4.2551E-01	2.0027E-01	8.5216E-02	8.5216E-02	5.9187E-01	1.0000E+00
30	1.6530E+00	1.9200E+00	4.5289E-01	1.4973E-01	6.7813E-02	6.7813E-02	5.0665E-01	1.0000E+00
31	1.9200E+00	2.2310E+00	4.6297E-01	1.5012E-01	6.9504E-02	6.9504E-02	4.3884E-01	1.0000E+00
32	2.2310E+00	2.3460E+00	4.6191E-01	5.0262E-02	2.3216E-02	2.3216E-02	3.6933E-01	1.0000E+00
33	2.3460E+00	2.3650E+00	4.6044E-01	8.0663E-03	3.7140E-03	3.7140E-03	3.4612E-01	1.0000E+00
34	2.3650E+00	2.4660E+00	4.5807E-01	4.1819E-02	1.9156E-02	1.9156E-02	3.4240E-01	1.0000E+00
35	2.4660E+00	2.7250E+00	4.4938E-01	9.9871E-02	4.4880E-02	4.4880E-02	3.2325E-01	1.0000E+00
36	2.7250E+00	3.0120E+00	4.3094E-01	1.0014E-01	4.3153E-02	4.3153E-02	2.7837E-01	1.0000E+00
37	3.0120E+00	3.6790E+00	3.8832E-01	2.0004E-01	7.7677E-02	7.7677E-02	2.3521E-01	1.0000E+00
38	3.6790E+00	4.9660E+00	2.9020E-01	2.9997E-01	8.7052E-02	8.7052E-02	1.5754E-01	1.0000E+00
39	4.9660E+00	6.0650E+00	1.8050E-01	1.9992E-01	3.6085E-02	3.6085E-02	7.0484E-02	1.0000E+00
40	6.0650E+00	7.4080E+00	1.0225E-01	2.0003E-01	2.0452E-02	2.0452E-02	3.4400E-02	1.0000E+00
41	7.4080E+00	8.6070E+00	5.1898E-02	1.5002E-01	7.7855E-03	7.7855E-03	1.3947E-02	1.0000E+00
42	8.6070E+00	1.0000E+01	2.5358E-02	1.5001E-01	3.8040E-03	3.8040E-03	6.1617E-03	1.0000E+00
43	1.0000E+01	1.2210E+01	9.3141E-03	1.9967E-01	1.8597E-03	1.8597E-03	2.3577E-03	1.0000E+00
44	1.2210E+01	1.4190E+01	2.5544E-03	1.5028E-01	3.8388E-04	3.8388E-04	4.9798E-04	1.0000E+00
45	1.4190E+01	1.7330E+01	5.7081E-04	1.9990E-01	1.1411E-04	1.1411E-04	1.1411E-04	1.0000E+00

logout

U235F5 U235(N,F)FP ENDF/BVC DOSIMETRY FILE
XCF-5-N1 NBS EVALUATED CF FISSION SPECTRUM 5-24-83

BETA= 7.0420000E-01 EAV= 2.1194E+00 AVSIGMA= 1.23583E+00 SPECFN= 9 TOTAL FLUX= 1.00000E+00
TRUNCATED CROSS SECTION = 1.22258E+00 FOR 95. PERCENTILE, FLUX FRACTION =9.603E-01

ALL FLUXES NORMALIZED TO TOTAL FLUX = 1

MEDIAN ENERGY = 1.682E+00 95 PERCENTILE ENG = 2.244E-01 05 PERCENTILE ENG = 5.760E+00

GRP	ELOW	EHI	PHI(U)	DELTA-U	FLUX	RESPONSE	CUM RESP	AVSIG
1	4.1400E-07	8.7640E-07	2.5076E-10	7.4996E-01	1.8806E-10	1.0196E-08	9.9999E-01	6.7006E+01
2	8.7640E-07	1.8550E-06	7.7326E-10	7.4982E-01	5.7980E-10	1.6974E-08	9.9999E-01	3.6180E+01
3	1.8550E-06	5.0430E-06	2.9874E-09	1.0001E+00	2.9877E-09	3.7959E-08	9.9999E-01	1.5701E+01
4	5.0430E-06	1.0680E-05	1.0674E-08	7.5037E-01	8.0093E-09	3.7017E-07	9.9999E-01	5.7117E+01
5	1.0680E-05	3.7270E-05	5.2364E-08	1.2498E+00	6.5446E-08	2.8022E-06	9.9999E-01	5.2914E+01
6	3.7270E-05	1.0130E-04	2.6905E-07	9.9990E-01	2.6902E-07	6.8940E-06	9.9999E-01	3.1670E+01
7	1.0130E-04	2.1440E-04	9.6055E-07	7.4976E-01	7.2018E-07	1.1805E-05	9.9998E-01	2.0257E+01
8	2.1440E-04	4.4500E-04	2.9071E-06	7.3023E-01	2.1228E-06	2.6472E-05	9.9997E-01	1.5411E+01
9	4.4500E-04	1.5850E-03	1.4377E-05	1.2703E+00	1.8262E-05	1.2824E-04	9.9994E-01	8.6781E+00
10	1.5850E-03	3.3550E-03	5.9584E-05	7.4987E-01	4.4680E-05	1.9919E-04	9.9981E-01	5.5094E+00
11	3.3550E-03	7.1020E-03	1.8387E-04	7.4992E-01	1.3789E-04	4.3405E-04	9.9962E-01	3.8902E+00
12	7.1020E-03	1.5030E-02	5.6885E-04	7.4967E-01	4.2645E-04	9.5294E-04	9.9918E-01	2.7616E+00
13	1.5030E-02	2.1880E-02	1.2805E-03	3.7552E-01	4.8085E-04	8.8444E-04	9.9823E-01	2.2731E+00
14	2.1880E-02	2.4180E-02	1.8160E-03	9.9953E-02	1.8152E-04	3.1892E-04	9.9734E-01	2.1714E+00
15	2.4180E-02	2.6060E-02	2.0786E-03	7.4876E-02	1.5564E-04	2.6669E-04	9.9703E-01	2.1176E+00
16	2.6060E-02	3.1830E-02	2.5564E-03	2.0001E-01	5.1130E-04	8.5523E-04	9.9676E-01	2.0671E+00
17	3.1830E-02	4.0870E-02	3.6242E-03	2.4999E-01	9.0599E-04	1.4020E-03	9.9590E-01	1.9124E+00
18	4.0870E-02	6.7380E-02	6.5488E-03	4.9995E-01	3.2741E-03	4.7655E-03	9.9450E-01	1.7988E+00
19	6.7380E-02	1.1110E-01	1.4217E-02	5.0008E-01	7.1095E-03	9.2498E-03	9.8974E-01	1.6079E+00
20	1.1110E-01	1.8320E-01	3.1237E-02	5.0015E-01	1.5623E-02	1.8497E-02	9.8049E-01	1.4632E+00
21	1.8320E-01	2.9720E-01	6.7407E-02	4.8383E-01	3.2613E-02	3.4787E-02	9.6199E-01	1.3182E+00
22	2.9720E-01	3.6880E-01	1.0624E-01	2.1585E-01	2.2932E-02	2.3066E-02	9.2720E-01	1.2430E+00
23	3.6880E-01	4.9790E-01	1.4410E-01	3.0014E-01	4.3251E-02	4.1768E-02	9.0414E-01	1.1934E+00
24	4.9790E-01	6.0810E-01	1.8912E-01	1.9994E-01	3.7813E-02	3.5338E-02	8.6237E-01	1.1549E+00
25	6.0810E-01	7.4270E-01	2.3021E-01	1.9995E-01	4.6032E-02	4.2443E-02	8.2703E-01	1.1395E+00
26	7.4270E-01	8.2080E-01	2.6280E-01	9.9987E-02	2.6277E-02	2.4209E-02	7.8459E-01	1.1386E+00
27	8.2080E-01	1.0030E+00	3.0088E-01	2.0047E-01	6.0317E-02	5.7511E-02	7.6038E-01	1.1784E+00
28	1.0030E+00	1.3530E+00	3.6756E-01	2.9933E-01	1.1002E-01	1.0869E-01	7.0287E-01	1.2209E+00
29	1.3530E+00	1.6530E+00	4.2551E-01	2.0027E-01	8.5216E-02	8.6336E-02	5.9418E-01	1.2521E+00
30	1.6530E+00	1.9200E+00	4.5289E-01	1.4973E-01	6.7813E-02	7.0497E-02	5.0784E-01	1.2848E+00
31	1.9200E+00	2.2310E+00	4.6297E-01	1.5012E-01	6.9504E-02	7.2819E-02	4.3734E-01	1.2948E+00
32	2.2310E+00	2.3460E+00	4.6191E-01	5.0262E-02	2.3216E-02	2.4156E-02	3.6453E-01	1.2859E+00
33	2.3460E+00	2.3650E+00	4.6044E-01	8.0663E-03	3.7140E-03	3.8498E-03	3.4037E-01	1.2810E+00
34	2.3650E+00	2.4660E+00	4.5807E-01	4.1819E-02	1.9156E-02	1.9766E-02	3.3652E-01	1.2752E+00
35	2.4660E+00	2.7250E+00	4.4938E-01	9.9871E-02	4.4880E-02	4.5731E-02	3.1675E-01	1.2593E+00
36	2.7250E+00	3.0120E+00	4.3094E-01	1.0014E-01	4.3153E-02	4.3064E-02	2.7102E-01	1.2333E+00
37	3.0120E+00	3.6790E+00	3.8832E-01	2.0004E-01	7.7677E-02	7.4774E-02	2.2796E-01	1.1896E+00
38	3.6790E+00	4.9660E+00	2.9020E-01	2.9997E-01	8.7052E-02	7.9013E-02	1.5318E-01	1.1217E+00
39	4.9660E+00	6.0650E+00	1.8050E-01	1.9992E-01	3.6085E-02	3.0995E-02	7.4171E-02	1.0615E+00
40	6.0650E+00	7.4080E+00	1.0225E-01	2.0003E-01	2.0452E-02	2.3240E-02	4.3177E-02	1.4043E+00
41	7.4080E+00	8.6070E+00	5.1898E-02	1.5002E-01	7.7855E-03	1.1093E-02	1.9937E-02	1.7608E+00
42	8.6070E+00	1.0000E+01	2.5358E-02	1.5001E-01	3.8040E-03	5.4416E-03	8.8437E-03	1.7679E+00
43	1.0000E+01	1.2210E+01	9.3141E-03	1.9967E-01	1.8597E-03	2.6179E-03	3.4021E-03	1.7396E+00
44	1.2210E+01	1.4190E+01	2.5544E-03	1.5028E-01	3.8388E-04	5.9207E-04	7.8420E-04	1.9061E+00
45	1.4190E+01	1.7330E+01	5.7081E-04	1.9990E-01	1.1411E-04	1.9213E-04	1.9213E-04	2.0809E+00

logout

Sample Output from Problem 2

```
Fri Dec  9 13:17:38 EST 1994
You are in the UNICOS C-shell.


-   -   -   -   -   -   Cray Y-MP4E/232 (UNICOS 8.0.2.4)  -   -   -   -   -   -

PROBLEM SIGNING ON?  The Central Computing facility maintains a
  recorded status message (301-975-6560).  It's helpful to check that
  message if you experience problems signing on to one of the central
  computers.  If you prefer to speak with a person, especially after
  regular working hours, the console operator telephone is 301-975-2967.

-   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -
                                                                            ---
news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.040s,  Wallclock: 0.142s,  14.0% of 2-CPU Machine
 HWM mem: 207776, HWM stack: 26061, Stack overflows: 0
asa: 1 invalid input lines in standard input
      1CONST
    1     5

.100000E-070.250000E+000.800000E+000.150000E+010.600000E+010.200000E+02


.237000E+000.980000E-01-.332000E-010.370000E-020.180000E+00

.120000E+01-.140000E+000.240000E-01-.620000E-03-.300000E-01

.704200E+00

.213008E+01
```

```
CONST
XCF-5-N1        NBS EVALUATED CF FISSION SPECTRUM          5-24-83

BETA=  7.0420000E-01  EAV=  2.1194E+00  AVSIGMA=  1.00000E+00  SPECFN=   9    TOTAL FLUX=  9.99706E-01
                        TRUNCATED CROSS SECTION = 1.00000E+00  FOR  95. PERCENTILE,  FLUX FRACTION =9.500E-01

  ALL  FLUXES  NORMALIZED  TO  TOTAL FLUX  =  1

MEDIAN ENERGY = 1.678E+00    95 PERCENTILE ENG = 2.598E-01    05 PERCENTILE ENG = 5.498E+00
```

GRP	ELOW	EHI	PHI(U)	DELTA-U	FLUX	RESPONSE	CUM RESP	AVSIG
1	4.1400E-07	8.7640E-07	2.5076E-10	7.4996E-01	1.8806E-10	1.8806E-10	9.9999E-01	1.0000E+00
2	8.7640E-07	1.8550E-06	7.7326E-10	7.4982E-01	5.7980E-10	5.7980E-10	9.9999E-01	1.0000E+00
3	1.8550E-06	5.0430E-06	2.9874E-09	1.0001E+00	2.9877E-09	2.9877E-09	9.9999E-01	1.0000E+00
4	5.0430E-06	1.0680E-05	1.0674E-08	7.5037E-01	8.0093E-09	8.0093E-09	9.9999E-01	1.0000E+00
5	1.0680E-05	3.7270E-05	5.2364E-08	1.2498E+00	6.5446E-08	6.5446E-08	9.9999E-01	1.0000E+00
6	3.7270E-05	1.0130E-04	2.6905E-07	9.9990E-01	2.6902E-07	2.6902E-07	9.9999E-01	1.0000E+00
7	1.0130E-04	2.1440E-04	9.6055E-07	7.4976E-01	7.2018E-07	7.2018E-07	9.9999E-01	1.0000E+00
8	2.1440E-04	4.4500E-04	2.9071E-06	7.3023E-01	2.1228E-06	2.1228E-06	9.9999E-01	1.0000E+00
9	4.4500E-04	1.5850E-03	1.4377E-05	1.2703E+00	1.8262E-05	1.8262E-05	9.9999E-01	1.0000E+00
10	1.5850E-03	3.3550E-03	5.9584E-05	7.4987E-01	4.4680E-05	4.4680E-05	9.9997E-01	1.0000E+00
11	3.3550E-03	7.1020E-03	1.8387E-04	7.4992E-01	1.3789E-04	1.3789E-04	9.9993E-01	1.0000E+00
12	7.1020E-03	1.5030E-02	5.6885E-04	7.4967E-01	4.2645E-04	4.2645E-04	9.9979E-01	1.0000E+00
13	1.5030E-02	2.1880E-02	1.2805E-03	3.7552E-01	4.8085E-04	4.8085E-04	9.9936E-01	1.0000E+00
14	2.1880E-02	2.4180E-02	1.8160E-03	9.9953E-02	1.8152E-04	1.8152E-04	9.9888E-01	1.0000E+00
15	2.4180E-02	2.6060E-02	2.0786E-03	7.4876E-02	1.5564E-04	1.5564E-04	9.9870E-01	1.0000E+00
16	2.6060E-02	3.1830E-02	2.5564E-03	2.0001E-01	5.1130E-04	5.1130E-04	9.9855E-01	1.0000E+00
17	3.1830E-02	4.0870E-02	3.6242E-03	2.4999E-01	9.0599E-04	9.0599E-04	9.9803E-01	1.0000E+00
18	4.0870E-02	6.7380E-02	6.5488E-03	4.9995E-01	3.2741E-03	3.2741E-03	9.9713E-01	1.0000E+00
19	6.7380E-02	1.1110E-01	1.4217E-02	5.0008E-01	7.1095E-03	7.1095E-03	9.9385E-01	1.0000E+00
20	1.1110E-01	1.8320E-01	3.1237E-02	5.0015E-01	1.5623E-02	1.5623E-02	9.8675E-01	1.0000E+00
21	1.8320E-01	2.9720E-01	6.7407E-02	4.8383E-01	3.2613E-02	3.2613E-02	9.7112E-01	1.0000E+00
22	2.9720E-01	3.6880E-01	1.0624E-01	2.1585E-01	2.2932E-02	2.2932E-02	9.3851E-01	1.0000E+00
23	3.6880E-01	4.9790E-01	1.4410E-01	3.0014E-01	4.3251E-02	4.3251E-02	9.1558E-01	1.0000E+00
24	4.9790E-01	6.0810E-01	1.8912E-01	1.9994E-01	3.7813E-02	3.7813E-02	8.7233E-01	1.0000E+00
25	6.0810E-01	7.4270E-01	2.3021E-01	1.9995E-01	4.6032E-02	4.6032E-02	8.3451E-01	1.0000E+00
26	7.4270E-01	8.2080E-01	2.6280E-01	9.9987E-02	2.6277E-02	2.6277E-02	7.8848E-01	1.0000E+00
27	8.2080E-01	1.0030E+00	3.0088E-01	2.0047E-01	6.0317E-02	6.0317E-02	7.6220E-01	1.0000E+00
28	1.0030E+00	1.3530E+00	3.6756E-01	2.9933E-01	1.1002E-01	1.1002E-01	7.0189E-01	1.0000E+00
29	1.3530E+00	1.6530E+00	4.2551E-01	2.0027E-01	8.5216E-02	8.5216E-02	5.9187E-01	1.0000E+00
30	1.6530E+00	1.9200E+00	4.5289E-01	1.4973E-01	6.7813E-02	6.7813E-02	5.0665E-01	1.0000E+00
31	1.9200E+00	2.2310E+00	4.6297E-01	1.5012E-01	6.9504E-02	6.9504E-02	4.3884E-01	1.0000E+00
32	2.2310E+00	2.3460E+00	4.6191E-01	5.0262E-02	2.3216E-02	2.3216E-02	3.6933E-01	1.0000E+00
33	2.3460E+00	2.3650E+00	4.6044E-01	8.0663E-03	3.7140E-03	3.7140E-03	3.4612E-01	1.0000E+00
34	2.3650E+00	2.4660E+00	4.5807E-01	4.1819E-02	1.9156E-02	1.9156E-02	3.4240E-01	1.0000E+00
35	2.4660E+00	2.7250E+00	4.4938E-01	9.9871E-02	4.4880E-02	4.4880E-02	3.2325E-01	1.0000E+00
36	2.7250E+00	3.0120E+00	4.3094E-01	1.0014E-01	4.3153E-02	4.3153E-02	2.7837E-01	1.0000E+00
37	3.0120E+00	3.6790E+00	3.8832E-01	2.0004E-01	7.7677E-02	7.7677E-02	2.3521E-01	1.0000E+00
38	3.6790E+00	4.9660E+00	2.9020E-01	2.9997E-01	8.7052E-02	8.7052E-02	1.5754E-01	1.0000E+00
39	4.9660E+00	6.0650E+00	1.8050E-01	1.9992E-01	3.6085E-02	3.6085E-02	7.0484E-02	1.0000E+00
40	6.0650E+00	7.4080E+00	1.0225E-01	2.0003E-01	2.0452E-02	2.0452E-02	3.4400E-02	1.0000E+00
41	7.4080E+00	8.6070E+00	5.1898E-02	1.5002E-01	7.7855E-03	7.7855E-03	1.3947E-02	1.0000E+00
42	8.6070E+00	1.0000E+01	2.5358E-02	1.5001E-01	3.8040E-03	3.8040E-03	6.1617E-03	1.0000E+00
43	1.0000E+01	1.2210E+01	9.3141E-03	1.9967E-01	1.8597E-03	1.8597E-03	2.3577E-03	1.0000E+00
44	1.2210E+01	1.4190E+01	2.5544E-03	1.5028E-01	3.8388E-04	3.8388E-04	4.9798E-04	1.0000E+00
45	1.4190E+01	1.7330E+01	5.7081E-04	1.9990E-01	1.1411E-04	1.1411E-04	1.1411E-04	1.0000E+00

```
PLOT=1 SENDS ENERGY AND RESPONSE SPECTRA TO MASS STORAGE FILE
logout
```

Sample Output from Problem 3

```
Fri Dec  9 13:13:58 EST 1994
You are in the UNICOS C-shell.


-   -   -   -   -   -  Cray Y-MP4E/232 (UNICOS 8.0.2.4)  -   -   -   -   -   -

PROBLEM SIGNING ON?  The Central Computing Facility maintains a
  recorded status message (301-975-6560).  It's helpful to check that
  message if you experience problems signing on to one of the central
  computers.  If you prefer to speak with a person, especially after
  regular working hours, the console operator telephone is 301-975-2967.

-   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.043s,  Wallclock: 0.141s,  15.2% of 2-CPU Machine
 HWM mem: 207776, HWM stack: 26061, Stack overflows: 0
      1CONST
```

xcf.46 NBS EVALUATED CF FISSION SPECTRUM 11-15-9

4.14000E-07	8.76400E-07	1.88057E-10	1.88057E-10	1.21334E-16
8.76400E-07	1.85500E-06	5.79801E-10	7.67858E-10	9.13169E-16
1.85500E-06	5.04300E-06	2.98770E-09	3.75556E-09	1.12177E-14
5.04300E-06	1.06800E-05	8.00932E-09	1.17649E-08	7.41830E-14
1.06800E-05	3.72700E-05	6.54459E-08	7.72108E-08	1.64325E-12
3.72700E-05	1.01300E-04	2.69018E-07	3.46229E-07	2.02822E-11
1.01300E-04	2.14400E-04	7.20177E-07	1.06641E-06	1.33962E-10
2.14400E-04	4.45000E-04	2.12284E-06	3.18925E-06	8.33862E-10
4.45000E-04	1.58500E-03	1.82624E-05	2.14516E-05	1.93702E-08
1.58500E-03	3.35500E-03	4.46804E-05	6.61320E-05	1.29731E-07
3.35500E-03	7.10200E-03	1.37887E-04	2.04019E-04	8.50673E-07
7.10200E-03	1.50300E-02	4.26452E-04	6.30471E-04	5.56979E-06
1.50300E-02	2.18800E-02	4.80852E-04	1.11132E-03	1.44439E-05
2.18800E-02	2.41800E-02	1.81515E-04	1.29284E-03	1.86242E-05
2.41800E-02	2.60600E-02	1.55638E-04	1.44848E-03	2.25338E-05
2.60600E-02	3.18300E-02	5.11304E-04	1.95978E-03	3.73335E-05
3.18300E-02	4.08700E-02	9.05993E-04	2.86577E-03	7.02664E-05
4.08700E-02	6.73800E-02	3.27410E-03	6.13987E-03	2.47477E-04
6.73800E-02	1.11100E-01	7.10954E-03	1.32494E-02	8.81932E-04
1.11100E-01	1.83200E-01	1.56230E-02	2.88724E-02	3.18086E-03
1.83200E-01	2.97200E-01	3.26133E-02	6.14857E-02	1.10146E-02
2.97200E-01	3.68800E-01	2.29325E-02	8.44182E-02	1.86511E-02
3.68800E-01	4.97900E-01	4.32514E-02	1.27670E-01	3.73941E-02
4.97900E-01	6.08100E-01	3.78134E-02	1.65483E-01	5.83049E-02
6.08100E-01	7.42700E-01	4.60321E-02	2.11515E-01	8.93950E-02
7.42700E-01	8.20800E-01	2.62770E-02	2.37792E-01	1.09937E-01
8.20800E-01	1.00300E+00	6.03169E-02	2.98109E-01	1.64940E-01
1.00300E+00	1.35300E+00	1.10020E-01	4.08129E-01	2.94544E-01
1.35300E+00	1.65300E+00	8.52165E-02	4.93346E-01	4.22624E-01
1.65300E+00	1.92000E+00	6.78126E-02	5.61158E-01	5.43771E-01
1.92000E+00	2.23100E+00	6.95035E-02	6.30662E-01	6.88026E-01
2.23100E+00	2.34600E+00	2.32163E-02	6.53878E-01	7.41156E-01
2.34600E+00	2.36500E+00	3.71404E-03	6.57592E-01	7.49905E-01
2.36500E+00	2.46600E+00	1.91563E-02	6.76748E-01	7.96177E-01
2.46600E+00	2.72500E+00	4.48801E-02	7.21628E-01	9.12663E-01
2.72500E+00	3.01200E+00	4.31528E-02	7.64781E-01	1.03645E+00
3.01200E+00	3.67900E+00	7.76773E-02	8.42458E-01	1.29632E+00
3.67900E+00	4.96600E+00	8.70516E-02	9.29510E-01	1.67260E+00
4.96600E+00	6.06500E+00	3.60848E-02	9.65595E-01	1.87162E+00
6.06500E+00	7.40800E+00	2.04523E-02	9.86047E-01	2.00940E+00
7.40800E+00	8.60700E+00	7.78554E-03	9.93833E-01	2.07174E+00
8.60700E+00	1.00000E+01	3.80398E-03	9.97637E-01	2.10713E+00
1.00000E+01	1.22100E+01	1.85974E-03	9.99496E-01	2.12778E+00
1.22100E+01	1.41900E+01	3.83878E-04	9.99880E-01	2.13285E+00
1.41900E+01	1.73300E+01	1.14107E-04	9.99994E-01	2.13465E+00

.213466E+01

CONST
xcf.46 NBS EVALUATED CF FISSION SPECTRUM 11-15-94

BETA= 7.0420000E-01 EAV= 2.1347E+00 AVSIGMA= 1.00000E+00 SPECFN= 4 TOTAL FLUX= 9.99994E-01
TRUNCATED CROSS SECTION = 1.00000E+00 FOR 95. PERCENTILE, FLUX FRACTION =9.500E-01

ALL FLUXES NORMALIZED TO TOTAL FLUX = 1

MEDIAN ENERGY = 1.678E+00 95 PERCENTILE ENG = 2.577E-01 05 PERCENTILE ENG = 5.491E+00

GRP	ELOW	EHI	PHI(U)	DELTA-U	FLUX	RESPONSE	CUM RESP	AVSIG
1	4.1400E-07	8.7640E-07	2.4500E-10	7.4996E-01	1.8374E-10	1.8374E-10	1.0000E+00	1.0000E+00
2	8.7640E-07	1.8550E-06	7.5877E-10	7.4982E-01	5.6894E-10	5.6894E-10	1.0000E+00	1.0000E+00
3	1.8550E-06	5.0430E-06	2.9644E-09	1.0001E+00	2.9648E-09	2.9648E-09	1.0000E+00	1.0000E+00
4	5.0430E-06	1.0680E-05	1.0434E-08	7.5037E-01	7.8294E-09	7.8294E-09	1.0000E+00	1.0000E+00
5	1.0680E-05	3.7270E-05	5.1970E-08	1.2498E+00	6.4953E-08	6.4953E-08	1.0000E+00	1.0000E+00
6	3.7270E-05	1.0130E-04	2.6823E-07	9.9990E-01	2.6820E-07	2.6820E-07	1.0000E+00	1.0000E+00
7	1.0130E-04	2.1440E-04	9.3961E-07	7.4976E-01	7.0448E-07	7.0448E-07	1.0000E+00	1.0000E+00
8	2.1440E-04	4.4500E-04	2.8655E-06	7.3023E-01	2.0924E-06	2.0924E-06	1.0000E+00	1.0000E+00
9	4.4500E-04	1.5850E-03	1.4350E-05	1.2703E+00	1.8228E-05	1.8228E-05	1.0000E+00	1.0000E+00
10	1.5850E-03	3.3550E-03	5.9133E-05	7.4987E-01	4.4342E-05	4.4342E-05	9.9998E-01	1.0000E+00
11	3.3550E-03	7.1020E-03	1.8435E-04	7.4992E-01	1.3825E-04	1.3825E-04	9.9993E-01	1.0000E+00
12	7.1020E-03	1.5030E-02	5.6940E-04	7.4967E-01	4.2686E-04	4.2686E-04	9.9980E-01	1.0000E+00
13	1.5030E-02	2.1880E-02	1.2805E-03	3.7552E-01	4.8084E-04	4.8084E-04	9.9937E-01	1.0000E+00
14	2.1880E-02	2.4180E-02	1.8143E-03	9.9953E-02	1.8134E-04	1.8134E-04	9.9889E-01	1.0000E+00
15	2.4180E-02	2.6060E-02	2.0816E-03	7.4876E-02	1.5586E-04	1.5586E-04	9.9871E-01	1.0000E+00
16	2.6060E-02	3.1830E-02	2.5501E-03	2.0001E-01	5.1004E-04	5.1004E-04	9.9855E-01	1.0000E+00
17	3.1830E-02	4.0870E-02	3.6039E-03	2.4999E-01	9.0094E-04	9.0094E-04	9.9804E-01	1.0000E+00
18	4.0870E-02	6.7380E-02	6.5442E-03	4.9995E-01	3.2718E-03	3.2718E-03	9.9714E-01	1.0000E+00
19	6.7380E-02	1.1110E-01	1.4212E-02	5.0008E-01	7.1070E-03	7.1070E-03	9.9387E-01	1.0000E+00
20	1.1110E-01	1.8320E-01	3.1401E-02	5.0015E-01	1.5705E-02	1.5705E-02	9.8676E-01	1.0000E+00
21	1.8320E-01	2.9720E-01	6.7328E-02	4.8383E-01	3.2575E-02	3.2575E-02	9.7106E-01	1.0000E+00
22	2.9720E-01	3.6880E-01	1.0623E-01	2.1585E-01	2.2929E-02	2.2929E-02	9.3848E-01	1.0000E+00
23	3.6880E-01	4.9790E-01	1.4409E-01	3.0014E-01	4.3248E-02	4.3248E-02	9.1555E-01	1.0000E+00
24	4.9790E-01	6.0810E-01	1.8928E-01	1.9994E-01	3.7845E-02	3.7845E-02	8.7230E-01	1.0000E+00
25	6.0810E-01	7.4270E-01	2.3016E-01	1.9995E-01	4.6021E-02	4.6021E-02	8.3446E-01	1.0000E+00
26	7.4270E-01	8.2080E-01	2.6257E-01	9.9987E-02	2.6253E-02	2.6253E-02	7.8844E-01	1.0000E+00
27	8.2080E-01	1.0030E+00	3.0105E-01	2.0047E-01	6.0352E-02	6.0352E-02	7.6218E-01	1.0000E+00
28	1.0030E+00	1.3530E+00	3.6819E-01	2.9933E-01	1.1021E-01	1.1021E-01	7.0183E-01	1.0000E+00
29	1.3530E+00	1.6530E+00	4.2444E-01	2.0027E-01	8.5001E-02	8.5001E-02	5.9162E-01	1.0000E+00
30	1.6530E+00	1.9200E+00	4.5269E-01	1.4973E-01	6.7782E-02	6.7782E-02	5.0662E-01	1.0000E+00
31	1.9200E+00	2.2310E+00	4.6281E-01	1.5012E-01	6.9479E-02	6.9479E-02	4.3884E-01	1.0000E+00
32	2.2310E+00	2.3460E+00	4.6215E-01	5.0262E-02	2.3228E-02	2.3228E-02	3.6936E-01	1.0000E+00
33	2.3460E+00	2.3650E+00	4.6075E-01	8.0663E-03	3.7165E-03	3.7165E-03	3.4613E-01	1.0000E+00
34	2.3650E+00	2.4660E+00	4.5798E-01	4.1819E-02	1.9152E-02	1.9152E-02	3.4242E-01	1.0000E+00
35	2.4660E+00	2.7250E+00	4.4947E-01	9.9871E-02	4.4889E-02	4.4889E-02	3.2326E-01	1.0000E+00
36	2.7250E+00	3.0120E+00	4.3110E-01	1.0014E-01	4.3169E-02	4.3169E-02	2.7838E-01	1.0000E+00
37	3.0120E+00	3.6790E+00	3.8792E-01	2.0004E-01	7.7599E-02	7.7599E-02	2.3521E-01	1.0000E+00
38	3.6790E+00	4.9660E+00	2.9022E-01	2.9997E-01	8.7057E-02	8.7057E-02	1.5761E-01	1.0000E+00
39	4.9660E+00	6.0650E+00	1.8078E-01	1.9992E-01	3.6142E-02	3.6142E-02	7.0551E-02	1.0000E+00
40	6.0650E+00	7.4080E+00	1.0229E-01	2.0003E-01	2.0461E-02	2.0461E-02	3.4409E-02	1.0000E+00
41	7.4080E+00	8.6070E+00	5.1916E-02	1.5002E-01	7.7882E-03	7.7882E-03	1.3948E-02	1.0000E+00
42	8.6070E+00	1.0000E+01	2.5346E-02	1.5001E-01	3.8021E-03	3.8021E-03	6.1599E-03	1.0000E+00
43	1.0000E+01	1.2210E+01	9.3178E-03	1.9967E-01	1.8605E-03	1.8605E-03	2.3577E-03	1.0000E+00
44	1.2210E+01	1.4190E+01	2.5524E-03	1.5028E-01	3.8358E-04	3.8358E-04	4.9725E-04	1.0000E+00
45	1.4190E+01	1.7330E+01	5.6864E-04	1.9990E-01	1.1367E-04	1.1367E-04	1.1367E-04	1.0000E+00

U235F5 U235(N,F)FP ENDF/BVC DOSIMETRY FILE
xcf.46 NBS EVALUATED CF FISSION SPECTRUM 11-15-94

BETA= 7.0420000E-01 EAV= 2.1347E+00 AVSIGMA= 1.23583E+00 SPECFN= 4 TOTAL FLUX= 1.00000E+00
TRUNCATED CROSS SECTION = 1.22259E+00 FOR 95. PERCENTILE, FLUX FRACTION =9.603E-01

ALL FLUXES NORMALIZED TO TOTAL FLUX = 1

MEDIAN ENERGY = 1.682E+00 95 PERCENTILE ENG = 2.222E-01 05 PERCENTILE ENG = 5.754E+00

GRP	ELOW	EHI	PHI(U)	DELTA-U	FLUX	RESPONSE	CUM RESP	AVSIG
1	4.1400E-07	8.7640E-07	2.4500E-10	7.4996E-01	1.8374E-10	1.0539E-08	1.0000E+00	7.0884E+01
2	8.7640E-07	1.8550E-06	7.5877E-10	7.4982E-01	5.6894E-10	1.4762E-08	1.0000E+00	3.2065E+01
3	1.8550E-06	5.0430E-06	2.9644E-09	1.0001E+00	2.9648E-09	3.8886E-08	1.0000E+00	1.6209E+01
4	5.0430E-06	1.0680E-05	1.0434E-08	7.5037E-01	7.8294E-09	4.1191E-07	1.0000E+00	6.5018E+01
5	1.0680E-05	3.7270E-05	5.1970E-08	1.2498E+00	6.4953E-08	2.7996E-06	1.0000E+00	5.3266E+01
6	3.7270E-05	1.0130E-04	2.6823E-07	9.9990E-01	2.6820E-07	6.8371E-06	1.0000E+00	3.1504E+01
7	1.0130E-04	2.1440E-04	9.3961E-07	7.4976E-01	7.0448E-07	1.1566E-05	9.9999E-01	2.0289E+01
8	2.1440E-04	4.4500E-04	2.8655E-06	7.3023E-01	2.0924E-06	2.4530E-05	9.9998E-01	1.4488E+01
9	4.4500E-04	1.5850E-03	1.4350E-05	1.2703E+00	1.8228E-05	1.2535E-04	9.9995E-01	8.4987E+00
10	1.5850E-03	3.3550E-03	5.9133E-05	7.4987E-01	4.4342E-05	1.9546E-04	9.9983E-01	5.4474E+00
11	3.3550E-03	7.1020E-03	1.8435E-04	7.4992E-01	1.3825E-04	4.3125E-04	9.9963E-01	3.8550E+00
12	7.1020E-03	1.5030E-02	5.6940E-04	7.4967E-01	4.2686E-04	9.5632E-04	9.9920E-01	2.7687E+00
13	1.5030E-02	2.1880E-02	1.2805E-03	3.7552E-01	4.8084E-04	8.8500E-04	9.9825E-01	2.2746E+00
14	2.1880E-02	2.4180E-02	1.8143E-03	9.9953E-02	1.8134E-04	3.1844E-04	9.9736E-01	2.1701E+00
15	2.4180E-02	2.6060E-02	2.0816E-03	7.4876E-02	1.5586E-04	2.6706E-04	9.9704E-01	2.1175E+00
16	2.6060E-02	3.1830E-02	2.5501E-03	2.0001E-01	5.1004E-04	8.5315E-04	9.9677E-01	2.0672E+00
17	3.1830E-02	4.0870E-02	3.6039E-03	2.4999E-01	9.0094E-04	1.3922E-03	9.9592E-01	1.9097E+00
18	4.0870E-02	6.7380E-02	6.5442E-03	4.9995E-01	3.2718E-03	4.7622E-03	9.9453E-01	1.7988E+00
19	6.7380E-02	1.1110E-01	1.4212E-02	5.0008E-01	7.1070E-03	9.2355E-03	9.8977E-01	1.6060E+00
20	1.1110E-01	1.8320E-01	3.1401E-02	5.0015E-01	1.5705E-02	1.8583E-02	9.8053E-01	1.4622E+00
21	1.8320E-01	2.9720E-01	6.7328E-02	4.8383E-01	3.2575E-02	3.4795E-02	9.6195E-01	1.3200E+00
22	2.9720E-01	3.6880E-01	1.0623E-01	2.1585E-01	2.2929E-02	2.3057E-02	9.2715E-01	1.2427E+00
23	3.6880E-01	4.9790E-01	1.4409E-01	3.0014E-01	4.3248E-02	4.1774E-02	9.0410E-01	1.1937E+00
24	4.9790E-01	6.0810E-01	1.8928E-01	1.9994E-01	3.7845E-02	3.5366E-02	8.6232E-01	1.1549E+00
25	6.0810E-01	7.4270E-01	2.3016E-01	1.9995E-01	4.6021E-02	4.2433E-02	8.2696E-01	1.1395E+00
26	7.4270E-01	8.2080E-01	2.6257E-01	9.9987E-02	2.6253E-02	2.4188E-02	7.8452E-01	1.1386E+00
27	8.2080E-01	1.0030E+00	3.0105E-01	2.0047E-01	6.0352E-02	5.7543E-02	7.6034E-01	1.1783E+00
28	1.0030E+00	1.3530E+00	3.6819E-01	2.9933E-01	1.1021E-01	1.0887E-01	7.0279E-01	1.2208E+00
29	1.3530E+00	1.6530E+00	4.2444E-01	2.0027E-01	8.5001E-02	8.6121E-02	5.9392E-01	1.2521E+00
30	1.6530E+00	1.9200E+00	4.5269E-01	1.4973E-01	6.7782E-02	7.0465E-02	5.0780E-01	1.2848E+00
31	1.9200E+00	2.2310E+00	4.6281E-01	1.5012E-01	6.9479E-02	7.2793E-02	4.3733E-01	1.2948E+00
32	2.2310E+00	2.3460E+00	4.6215E-01	5.0262E-02	2.3228E-02	2.4169E-02	3.6454E-01	1.2859E+00
33	2.3460E+00	2.3650E+00	4.6075E-01	8.0663E-03	3.7165E-03	3.8524E-03	3.4037E-01	1.2810E+00
34	2.3650E+00	2.4660E+00	4.5798E-01	4.1819E-02	1.9152E-02	1.9762E-02	3.3652E-01	1.2752E+00
35	2.4660E+00	2.7250E+00	4.4947E-01	9.9871E-02	4.4889E-02	4.5740E-02	3.1676E-01	1.2592E+00
36	2.7250E+00	3.0120E+00	4.3110E-01	1.0014E-01	4.3169E-02	4.3081E-02	2.7102E-01	1.2333E+00
37	3.0120E+00	3.6790E+00	3.8792E-01	2.0004E-01	7.7599E-02	7.4703E-02	2.2794E-01	1.1897E+00
38	3.6790E+00	4.9660E+00	2.9022E-01	2.9997E-01	8.7057E-02	7.8977E-02	1.5323E-01	1.1211E+00
39	4.9660E+00	6.0650E+00	1.8078E-01	1.9992E-01	3.6142E-02	3.1037E-02	7.4258E-02	1.0613E+00
40	6.0650E+00	7.4080E+00	1.0229E-01	2.0003E-01	2.0461E-02	2.3289E-02	4.3220E-02	1.4066E+00
41	7.4080E+00	8.6070E+00	5.1916E-02	1.5002E-01	7.7882E-03	1.1094E-02	1.9931E-02	1.7604E+00
42	8.6070E+00	1.0000E+01	2.5346E-02	1.5001E-01	3.8021E-03	5.4394E-03	8.8371E-03	1.7680E+00
43	1.0000E+01	1.2210E+01	9.3178E-03	1.9967E-01	1.8605E-03	2.6184E-03	3.3977E-03	1.7393E+00
44	1.2210E+01	1.4190E+01	2.5524E-03	1.5028E-01	3.8358E-04	5.8748E-04	7.7923E-04	1.8928E+00
45	1.4190E+01	1.7330E+01	5.6864E-04	1.9990E-01	1.1367E-04	1.9175E-04	1.9175E-04	2.0847E+00

logout

Sample Output from Problem 4

```
Wed Nov 16 08:50:43 EST 1994
You are in the UNICOS C-shell.

- - - - - - Cray Y-MP4E/232 (UNICOS 8.0.2.4) - - - - - -

UNICOS UPGRADE -- UNICOS has been upgraded from level 8.0.2.2 to
  the corrective code level 8.0.2.4. (11/8/94)

NAG UPGRADE - Effective November 7, 1994, NAG Mark 16 will replace NAG
  Mark 15 as the NAG Fortran Library on granta. For Mark 16, 126 new primary
  routines have been introduced, and 34 deleted.  For more information,
  please type:  hp nag

COMPILER AND LIBRARY UPGRADE -- The Cray compilers cf77 and f90
  were upgraded to levels 6.0.3.24 and 1.0.1.8 on Friday November
  4.  CrayLibs and CrayTools were upgraded to levels 1.1.0.1 and
  1.2.1.0.  These were code fix releases and involved no new user
  features.

- - - - - - - - - - - - - - - - - - - - -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.494s,  Wallclock: 0.893s,  27.7% of 2-CPU Machine
 HWM mem: 203680, HWM stack: 26061, Stack overflows: 0
      1CONST
    1     5

.100000E-070.250000E+000.800000E+000.150000E+010.600000E+010.200000E+02


.237000E+000.980000E-01-.332000E-010.370000E-020.180000E+00

.120000E+01-.140000E+000.240000E-01-.620000E-03-.300000E-01

.704200E+00

.213008E+01
```

IF=4 NC=0

LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX	LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX
4.14000E-07	1.88057E-10	9.99995E-01	6.08100E-01	4.60321E-02	8.34512E-01
8.76400E-07	5.79801E-10	9.99995E-01	7.42700E-01	2.62770E-02	7.88480E-01
1.85500E-06	2.98770E-09	9.99995E-01	8.20800E-01	6.03169E-02	7.62203E-01
5.04300E-06	8.00932E-09	9.99995E-01	1.00300E+00	1.10020E-01	7.01886E-01
1.06800E-05	6.54459E-08	9.99995E-01	1.35300E+00	8.52165E-02	5.91865E-01
3.72700E-05	2.69018E-07	9.99995E-01	1.65300E+00	6.78126E-02	5.06649E-01
1.01300E-04	7.20177E-07	9.99994E-01	1.92000E+00	6.95035E-02	4.38836E-01
2.14400E-04	2.12284E-06	9.99994E-01	2.23100E+00	2.32163E-02	3.69333E-01
4.45000E-04	1.82624E-05	9.99992E-01	2.34600E+00	3.71404E-03	3.46116E-01
1.58500E-03	4.46804E-05	9.99973E-01	2.36500E+00	1.91563E-02	3.42402E-01
3.35500E-03	1.37887E-04	9.99929E-01	2.46600E+00	4.48801E-02	3.23246E-01
7.10200E-03	4.26452E-04	9.99791E-01	2.72500E+00	4.31528E-02	2.78366E-01
1.50300E-02	4.80852E-04	9.99364E-01	3.01200E+00	7.76773E-02	2.35213E-01
2.18800E-02	1.81515E-04	9.98883E-01	3.67900E+00	8.70516E-02	1.57536E-01
2.41800E-02	1.55638E-04	9.98702E-01	4.96600E+00	3.60848E-02	7.04843E-02
2.60600E-02	5.11304E-04	9.98546E-01	6.06500E+00	2.04523E-02	3.43995E-02
3.18300E-02	9.05993E-04	9.98035E-01	7.40800E+00	7.78554E-03	1.39472E-02
4.08700E-02	3.27410E-03	9.97129E-01	8.60700E+00	3.80398E-03	6.16171E-03
6.73800E-02	7.10954E-03	9.93855E-01	1.00000E+01	1.85974E-03	2.35772E-03
1.11100E-01	1.56230E-02	9.86745E-01	1.22100E+01	3.83878E-04	4.97984E-04
1.83200E-01	3.26133E-02	9.71122E-01	1.41900E+01	1.14107E-04	1.14107E-04
2.97200E-01	2.29325E-02	9.38509E-01	1.73300E+01	0.00000E+00	0.00000E+00

TOTAL FLUX 9.99706E-01

SPECTRUM, NBS EVALUATED CF FISSION SPECTRUM DESIGNATION, XCF-5-N1

CROSS SECTIONS, ENTRY DATE, 5-24-8

FLUX GREATER THAN 1 MEV, 0.703 REVISED, 3

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
SPECTRUM CHECK	1.000E+00	1.000E+00	9.500E-01	1.678E+00	2.598E-01	5.498E+00
RECP VEL 1/V	1.107E-01	1.062E-01	9.906E-01	9.954E-01	8.898E-02	4.251E+00
FISSIONABLE MATERIALS						
PU239(N,F)FP	1.792E+00	1.807E+00	9.421E-01	1.752E+00	2.859E-01	5.672E+00
U235(N,F)FP	1.236E+00	1.223E+00	9.603E-01	1.682E+00	2.244E-01	5.760E+00
U233(N,F)FP	1.904E+00	1.888E+00	9.583E-01	1.616E+00	2.317E-01	5.495E+00
NP237(N,F)F.	1.352E+00	1.591E+00	8.073E-01	2.062E+00	6.878E-01	6.168E+00
U238(N,F)FP	3.136E-01	5.413E-01	5.504E-01	2.789E+00	1.496E+00	7.220E+00
TH232(N,F)F.	7.807E-02	1.360E-01	5.454E-01	3.014E+00	1.513E+00	7.684E+00
PU240(N,F)FP	1.356E+00	1.598E+00	8.058E-01	2.065E+00	6.919E-01	6.111E+00
PU241(N,F)FP	1.595E+00	1.575E+00	9.624E-01	1.629E+00	2.169E-01	5.564E+00
AM241(N,F)FP	1.474E+00	1.920E+00	7.292E-01	2.242E+00	9.201E-01	6.213E+00
U238(N,G)U23	6.834E-02	6.553E-02	9.908E-01	8.993E-01	8.789E-02	2.805E+00
TH232(N,G)TH	8.968E-02	8.630E-02	9.872E-01	9.182E-01	1.089E-01	2.924E+00
CAPTURE REACTIONS						
NA23(N,G)NA2	2.712E-04	2.588E-04	9.955E-01	9.482E-01	5.467E-02	4.730E+00
SC45(N,G)SC4	5.260E-03	5.011E-03	9.971E-01	6.544E-01	4.121E-02	2.872E+00
FE58(N,G)FE5	1.660E-03	1.587E-03	9.939E-01	1.066E+00	6.682E-02	4.833E+00
CO59(N,G)CO6	6.028E-03	5.762E-03	9.938E-01	1.077E+00	6.785E-02	4.035E+00
CU63(N,G)CU6	9.649E-03	9.223E-03	9.939E-01	9.797E-01	6.720E-02	4.039E+00
IN115(N,G)IN	1.212E-01	1.169E-01	9.856E-01	1.119E+00	1.173E-01	2.952E+00
AU197(N,G)AU	7.633E-02	7.296E-02	9.938E-01	7.457E-01	6.777E-02	2.977E+00

SPECTRUM, NBS EVALUATED CF FISSION SPECTRUM DESIGNATION,XCF-5-N1

CROSS SECTIONS, ENDF/BVC DOSIMETRY FILE ENTRY DATE, 5-24-8

FLUX GREATER THAN 1 MEV, 0.703 REVISED, 3

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
HELIUM PRODUCTION						
B10(N,A)LI7	4.889E-01	4.681E-01	9.923E-01	1.439E+00	7.845E-02	5.593E+00
LI6(N,A)H3	4.646E-01	4.540E-01	9.722E-01	1.552E+00	1.789E-01	6.036E+00
THRESHOLD REACTIONS						
IN115(N,N)IN	1.819E-01	2.698E-01	6.405E-01	2.708E+00	1.195E+00	5.239E+00
TI47(N,P)SC4	2.407E-02	5.197E-02	4.399E-01	3.912E+00	1.916E+00	7.997E+00
S32(N,P)P32	7.600E-02	2.062E-01	3.501E-01	4.119E+00	2.326E+00	7.870E+00
NI58(N,P)CO5	1.138E-01	2.845E-01	3.801E-01	4.214E+00	2.180E+00	7.943E+00
FE54(N,P)MN5	8.826E-02	2.487E-01	3.371E-01	4.301E+00	2.392E+00	7.996E+00
TI46(N,P)SC4	1.347E-02	8.852E-02	1.445E-01	5.911E+00	3.820E+00	9.867E+00
AL27(N,P)MG2	5.138E-03	2.790E-02	1.749E-01	5.991E+00	3.507E+00	9.834E+00
NI60(N,P)CO6	3.442E-03	4.571E-02	7.154E-02	7.250E+00	4.943E+00	1.092E+01
FE56(N,P)MN5	1.414E-03	2.786E-02	4.822E-02	7.550E+00	5.554E+00	1.180E+01
CU63(N,A)CO5	7.581E-04	9.718E-03	7.411E-02	7.702E+00	4.887E+00	1.152E+01
AL27(N,A)NA2	1.059E-03	4.077E-02	2.467E-02	8.642E+00	6.563E+00	1.241E+01
TI48(N,P)SC4	4.091E-04	1.099E-02	3.535E-02	8.403E+00	6.024E+00	1.279E+01
MN55(N,2N)MN	4.403E-04	4.005E-01	1.044E-03	1.286E+01	1.117E+01	1.606E+01
MISCELLANEOUS REACTIONS						
RH(N,N')	7.031E-01	8.493E-01	7.865E-01	2.372E+00	7.489E-01	5.956E+00
NB(N,N')93M	1.479E-01	1.960E-01	7.169E-01	2.675E+00	9.573E-01	6.081E+00
DPA(E-693)	8.947E+02	1.030E+03	8.253E-01	2.654E+00	6.351E-01	6.799E+00

logout

Sample Output from Problem 5

```
Tue Nov 15 11:37:53 EST 1994                    IF = 4 , NO = 0.
You are in the UNICOS C-shell.


-  -  -  -  -  -  Cray Y-MP4E/232 (UNICOS 8.0.2.4)  -  -  -  -  -  -

UNICOS UPGRADE -- UNICOS has been upgraded from level 8.0.2.2 to
  the corrective code level 8.0.2.4. (11/8/94)

NAG UPGRADE - Effective November 7, 1994, NAG Mark 16 will replace NAG
  Mark 15 as the NAG Fortran Library on granta. For Mark 16, 126 new primary
  routines have been introduced, and 34 deleted.  For more information,
  please type:  hp nag

COMPILER AND LIBRARY UPGRADE -- The Cray compilers cf77 and f90
  were upgraded to levels 6.0.3.24 and 1.0.1.8 on Friday November
  4.  CrayLibs and CrayTools were upgraded to levels 1.1.0.1 and
  1.2.1.0.  These were code fix releases and involved no new user
  features.

-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.500s,  Wallclock: 0.541s,  46.3% of 2-CPU Machine
 HWM mem: 207776, HWM stack: 26061, Stack overflows: 0
      1CONST
```

4.14000E-07	8.76400E-07	1.88057E-10	1.88057E-10	1.21334E-16
8.76400E-07	1.85500E-06	5.79801E-10	7.67858E-10	9.13169E-16
1.85500E-06	5.04300E-06	2.98770E-09	3.75556E-09	1.12177E-14
5.04300E-06	1.06800E-05	8.00932E-09	1.17649E-08	7.41830E-14
1.06800E-05	3.72700E-05	6.54459E-08	7.72108E-08	1.64325E-12
3.72700E-05	1.01300E-04	2.69018E-07	3.46229E-07	2.02822E-11
1.01300E-04	2.14400E-04	7.20177E-07	1.06641E-06	1.33962E-10
2.14400E-04	4.45000E-04	2.12284E-06	3.18925E-06	8.33862E-10
4.45000E-04	1.58500E-03	1.82624E-05	2.14516E-05	1.93702E-08
1.58500E-03	3.35500E-03	4.46804E-05	6.61320E-05	1.29731E-07
3.35500E-03	7.10200E-03	1.37887E-04	2.04019E-04	8.50673E-07
7.10200E-03	1.50300E-02	4.26452E-04	6.30471E-04	5.56979E-06
1.50300E-02	2.18800E-02	4.80852E-04	1.11132E-03	1.44439E-05
2.18800E-02	2.41800E-02	1.81515E-04	1.29284E-03	1.86242E-05
2.41800E-02	2.60600E-02	1.55638E-04	1.44848E-03	2.25338E-05
2.60600E-02	3.18300E-02	5.11304E-04	1.95978E-03	3.73335E-05
3.18300E-02	4.08700E-02	9.05993E-04	2.86577E-03	7.02664E-05
4.08700E-02	6.73800E-02	3.27410E-03	6.13987E-03	2.47477E-04
6.73800E-02	1.11100E-01	7.10954E-03	1.32494E-02	8.81932E-04
1.11100E-01	1.83200E-01	1.56230E-02	2.88724E-02	3.18086E-03
1.83200E-01	2.97200E-01	3.26133E-02	6.14857E-02	1.10146E-02
2.97200E-01	3.68800E-01	2.29325E-02	8.44182E-02	1.86511E-02
3.68800E-01	4.97900E-01	4.32514E-02	1.27670E-01	3.73941E-02
4.97900E-01	6.08100E-01	3.78134E-02	1.65483E-01	5.83049E-02
6.08100E-01	7.42700E-01	4.60321E-02	2.11515E-01	8.93950E-02
7.42700E-01	8.20800E-01	2.62770E-02	2.37792E-01	1.09937E-01
8.20800E-01	1.00300E+00	6.03169E-02	2.98109E-01	1.64940E-01
1.00300E+00	1.35300E+00	1.10020E-01	4.08129E-01	2.94544E-01
1.35300E+00	1.65300E+00	8.52165E-02	4.93346E-01	4.22624E-01
1.65300E+00	1.92000E+00	6.78126E-02	5.61158E-01	5.43771E-01
1.92000E+00	2.23100E+00	6.95035E-02	6.30662E-01	6.88026E-01
2.23100E+00	2.34600E+00	2.32163E-02	6.53878E-01	7.41156E-01
2.34600E+00	2.36500E+00	3.71404E-03	6.57592E-01	7.49905E-01
2.36500E+00	2.46600E+00	1.91563E-02	6.76748E-01	7.96177E-01
2.46600E+00	2.72500E+00	4.48801E-02	7.21628E-01	9.12663E-01
2.72500E+00	3.01200E+00	4.31528E-02	7.64781E-01	1.03645E+00
3.01200E+00	3.67900E+00	7.76773E-02	8.42458E-01	1.29632E+00
3.67900E+00	4.96600E+00	8.70516E-02	9.29510E-01	1.67260E+00
4.96600E+00	6.06500E+00	3.60848E-02	9.65595E-01	1.87162E+00
6.06500E+00	7.40800E+00	2.04523E-02	9.86047E-01	2.00940E+00
7.40800E+00	8.60700E+00	7.78554E-03	9.93833E-01	2.07174E+00
8.60700E+00	1.00000E+01	3.80398E-03	9.97637E-01	2.10713E+00
1.00000E+01	1.22100E+01	1.85974E-03	9.99496E-01	2.12778E+00
1.22100E+01	1.41900E+01	3.83878E-04	9.99880E-01	2.13285E+00
1.41900E+01	1.73300E+01	1.14107E-04	9.99994E-01	2.13465E+00

.213466E+01

LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX	LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX
1.00000E-10	3.86761E-03	1.00000E+00	3.00000E+00	5.03956E-02	2.36876E-01
5.00000E-02	7.37249E-03	9.96132E-01	3.40000E+00	3.08858E-02	1.86481E-01
1.00000E-01	2.21998E-02	9.88760E-01	3.70000E+00	4.03361E-02	1.55595E-01
2.00000E-01	1.43360E-02	9.66560E-01	4.20000E+00	2.55194E-02	1.15259E-01
2.50000E-01	1.45345E-02	9.52224E-01	4.60000E+00	2.07960E-02	8.97395E-02
3.00000E-01	3.25835E-02	9.37690E-01	5.00000E+00	1.92409E-02	6.89435E-02
4.00000E-01	3.34838E-02	9.05106E-01	5.50000E+00	1.38370E-02	4.97026E-02
5.00000E-01	3.43009E-02	8.71622E-01	6.00000E+00	1.00042E-02	3.58656E-02
6.00000E-01	3.44759E-02	8.37321E-01	6.50000E+00	7.42716E-03	2.58614E-02
7.00000E-01	3.35564E-02	8.02846E-01	7.00000E+00	5.34525E-03	1.84343E-02
8.00000E-01	6.64213E-02	7.69289E-01	7.50000E+00	3.85219E-03	1.30890E-02
1.00000E+00	6.46511E-02	7.02868E-01	8.00000E+00	2.64628E-03	9.23683E-03
1.20000E+00	6.02743E-02	6.38217E-01	8.50000E+00	1.89490E-03	6.59056E-03
1.40000E+00	2.88947E-02	5.77943E-01	9.00000E+00	1.39656E-03	4.69566E-03
1.50000E+00	2.79472E-02	5.49048E-01	9.50000E+00	9.41365E-04	3.29910E-03
1.60000E+00	5.26890E-02	5.21101E-01	1.00000E+01	1.17173E-03	2.35774E-03
1.80000E+00	4.84054E-02	4.68412E-01	1.10000E+01	6.16749E-04	1.18601E-03
2.00000E+00	4.41646E-02	4.20006E-01	1.20000E+01	3.11290E-04	5.69264E-04
2.20000E+00	2.05838E-02	3.75842E-01	1.30000E+01	1.36254E-04	2.57973E-04
2.30000E+00	1.96093E-02	3.55258E-01	1.40000E+01	1.03512E-04	1.21719E-04
2.40000E+00	3.63480E-02	3.35649E-01	1.60000E+01	1.82069E-05	1.82069E-05

TOTAL FLUX 9.99994E-01

SPECTRUM, NBS EVALUATED CF FISSION SPECTRUM DESIGNATION, XCF-5-N1

CROSS SECTIONS, ENTRY DATE, 11-15-9

FLUX GREATER THAN 1 MEV, 0.703 REVISED, 4

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
SPECTRUM CHECK	1.000E+00	1.000E+00	9.500E-01	1.678E+00	2.577E-01	5.491E+00
RECP VEL 1/V	1.107E-01	1.062E-01	9.906E-01	9.951E-01	8.955E-02	4.265E+00
FISSIONABLE MATERIALS						
PU239(N,F)FP	1.792E+00	1.807E+00	9.420E-01	1.752E+00	2.851E-01	5.665E+00
U235(N,F)FP	1.236E+00	1.223E+00	9.603E-01	1.682E+00	2.222E-01	5.754E+00
U233(N,F)FP	1.904E+00	1.888E+00	9.582E-01	1.616E+00	2.293E-01	5.489E+00
NP237(N,F)F.	1.352E+00	1.591E+00	8.072E-01	2.063E+00	6.874E-01	6.173E+00
U238(N,F)FP	3.135E-01	5.414E-01	5.501E-01	2.789E+00	1.496E+00	7.221E+00
TH232(N,F)F.	7.808E-02	1.361E-01	5.452E-01	3.015E+00	1.514E+00	7.678E+00
PU240(N,F)FP	1.356E+00	1.598E+00	8.058E-01	2.065E+00	6.916E-01	6.114E+00
PU241(N,F)FP	1.595E+00	1.575E+00	9.624E-01	1.629E+00	2.149E-01	5.558E+00
AM241(N,F)FP	1.474E+00	1.920E+00	7.291E-01	2.243E+00	9.201E-01	6.219E+00
U238(N,G)U23	6.835E-02	6.554E-02	9.907E-01	8.994E-01	8.862E-02	2.803E+00
TH232(N,G)TH	8.969E-02	8.632E-02	9.871E-01	9.180E-01	1.091E-01	2.922E+00
CAPTURE REACTIONS						
NA23(N,G)NA2	2.713E-04	2.588E-04	9.956E-01	9.476E-01	5.450E-02	4.741E+00
SC45(N,G)SC4	5.261E-03	5.013E-03	9.971E-01	6.540E-01	4.139E-02	2.871E+00
FE58(N,G)FE5	1.662E-03	1.588E-03	9.940E-01	1.063E+00	6.649E-02	4.839E+00
CO59(N,G)CO6	6.031E-03	5.765E-03	9.938E-01	1.075E+00	6.787E-02	4.044E+00
CU63(N,G)CU6	9.652E-03	9.225E-03	9.939E-01	9.793E-01	6.703E-02	4.049E+00
IN115(N,G)IN	1.213E-01	1.169E-01	9.856E-01	1.117E+00	1.180E-01	2.951E+00
AU197(N,G)AU	7.634E-02	7.298E-02	9.938E-01	7.455E-01	6.798E-02	2.976E+00

SPECTRUM, NBS EVALUATED CF FISSION SPECTRUM DESIGNATION,XCF-5-N1

CROSS SECTIONS, ENDF/BVC DOSIMETRY FILE ENTRY DATE, 11-15-9

FLUX GREATER THAN 1 MEV, 0.703 REVISED, 4

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
HELIUM PRODUCTION						
B10(N,A)LI7	4.892E-01	4.683E-01	9.922E-01	1.439E+00	7.923E-02	5.585E+00
LI6(N,A)H3	4.645E-01	4.539E-01	9.722E-01	1.553E+00	1.786E-01	6.036E+00
THRESHOLD REACTIONS						
IN115(N,N)IN	1.819E-01	2.698E-01	6.404E-01	2.709E+00	1.193E+00	6.244E+00
TI47(N,P)SC4	2.407E-02	5.200E-02	4.398E-01	3.921E+00	1.916E+00	7.982E+00
S32(N,P)P32	7.602E-02	2.063E-01	3.501E-01	4.128E+00	2.326E+00	7.859E+00
NI58(N,P)CO5	1.139E-01	2.848E-01	3.799E-01	4.229E+00	2.181E+00	7.929E+00
FE54(N,P)MN5	8.834E-02	2.490E-01	3.370E-01	4.316E+00	2.393E+00	7.982E+00
TI46(N,P)SC4	1.350E-02	8.877E-02	1.445E-01	5.902E+00	3.825E+00	9.851E+00
AL27(N,P)MG2	5.147E-03	2.797E-02	1.748E-01	5.986E+00	3.508E+00	9.819E+00
NI60(N,P)CO6	3.444E-03	4.532E-02	7.218E-02	7.244E+00	4.932E+00	1.094E+01
FE56(N,P)MN5	1.414E-03	2.786E-02	4.820E-02	7.545E+00	5.548E+00	1.177E+01
CU63(N,A)CO5	7.581E-04	9.627E-03	7.481E-02	7.688E+00	4.878E+00	1.151E+01
AL27(N,A)NA2	1.058E-03	4.063E-02	2.474E-02	8.642E+00	6.567E+00	1.239E+01
TI48(N,P)SC4	4.085E-04	1.101E-02	3.526E-02	8.387E+00	6.027E+00	1.270E+01
MN55(N,2N)MN	4.292E-04	3.839E-01	1.062E-03	1.276E+01	1.115E+01	1.577E+01
MISCELLANEOUS REACTIONS						
RH(N,N')	7.031E-01	8.494E-01	7.863E-01	2.373E+00	7.493E-01	5.952E+00
NB(N,N')93M	1.479E-01	1.960E-01	7.168E-01	2.676E+00	9.574E-01	6.082E+00
DPA(E-693)	8.948E+02	1.030E+03	8.256E-01	2.655E+00	6.337E-01	6.806E+00

logout

Sample Output from Problem 6

```
Wed Nov 16 08:22:18 EST 1994
You are in the UNICOS C-shell.

- - - - - - Cray Y-MP4E/232 (UNICOS 8.0.2.4) - - - - - -

UNICOS UPGRADE -- UNICOS has been upgraded from level 8.0.2.2 to
  the corrective code level 8.0.2.4. (11/8/94)

NAG UPGRADE - Effective November 7, 1994, NAG Mark 16 will replace NAG
  Mark 15 as the NAG Fortran Library on granta. For Mark 16, 126 new primary
  routines have been introduced, and 34 deleted.  For more information,
  please type:  hp nag

COMPILER AND LIBRARY UPGRADE -- The Cray compilers cf77 and f90
  were upgraded to levels 6.0.3.24 and 1.0.1.8 on Friday November
  4.  CrayLibs and CrayTools were upgraded to levels 1.1.0.1 and
  1.2.1.0.  These were code fix releases and involved no new user
  features.

- - - - - - - - - - - - - - - - - - - - -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.510s,  Wallclock: 0.571s,  44.6% of 2-CPU Machine
 HWM mem: 207776, HWM stack: 26061, Stack overflows: 0
      1CONST
```

xcfen6 cf spectrum, endfbvi tabulation Carlson 3-24-93

5.00000E-12	1.50000E-11	2.03300E-17	2.03300E-17	2.03300E-28
1.50000E-11	3.50000E-11	5.75000E-17	7.78300E-17	1.64080E-27
3.50000E-11	7.50000E-11	1.81840E-16	2.59670E-16	1.16420E-26
7.50000E-11	1.50000E-10	4.82250E-16	7.41920E-16	6.58951E-26
1.50000E-10	3.50000E-10	1.81860E-15	2.56052E-15	5.20545E-25
3.50000E-10	7.50000E-10	5.75200E-15	8.31252E-15	3.68415E-24
7.50000E-10	1.50000E-09	1.52475E-14	2.35600E-14	2.08376E-23
1.50000E-09	3.50000E-09	5.75000E-14	8.10600E-14	1.64588E-22
3.50000E-09	7.50000E-09	1.81840E-13	2.62900E-13	1.16471E-21
7.50000E-09	1.50000E-08	4.82250E-13	7.45150E-13	6.59002E-21
1.50000E-08	3.50000E-08	1.81860E-12	2.56375E-12	5.20550E-20
3.50000E-08	7.50000E-08	5.75200E-12	8.31575E-12	3.68415E-19
7.50000E-08	1.50000E-07	1.52475E-11	2.35633E-11	2.08376E-18
1.50000E-07	3.50000E-07	5.75000E-11	8.10633E-11	1.64588E-17
3.50000E-07	7.50000E-07	1.81840E-10	2.62903E-10	1.16471E-16
7.50000E-07	1.50000E-06	4.82250E-10	7.45153E-10	6.59002E-16
1.50000E-06	3.50000E-06	1.81860E-09	2.56375E-09	5.20550E-15
3.50000E-06	7.50000E-06	5.75200E-09	8.31575E-09	3.68415E-14
7.50000E-06	1.50000E-05	1.52475E-08	2.35633E-08	2.08376E-13
1.50000E-05	3.50000E-05	5.75000E-08	8.10633E-08	1.64588E-12
3.50000E-05	7.50000E-05	1.81840E-07	2.62903E-07	1.16471E-11
7.50000E-05	1.50000E-04	4.82175E-07	7.45078E-07	6.58918E-11
1.50000E-04	3.50000E-04	1.81840E-06	2.56348E-06	5.20492E-10
3.50000E-04	7.50000E-04	5.74800E-06	8.31148E-06	3.68189E-09
7.50000E-04	1.50000E-03	1.52400E-05	2.35515E-05	2.08269E-08
1.50000E-03	3.50000E-03	5.74200E-05	8.09715E-05	1.64377E-07
3.50000E-03	7.50000E-03	1.81200E-04	2.62171E-04	1.16098E-06
7.50000E-03	1.75000E-02	6.38500E-04	9.00671E-04	9.14223E-06
1.75000E-02	2.75000E-02	9.98900E-04	1.89957E-03	3.16175E-05
2.75000E-02	3.25000E-02	5.45000E-04	2.44457E-03	4.79675E-05
3.25000E-02	4.00000E-02	8.80500E-04	3.32507E-03	7.98856E-05
4.00000E-02	5.00000E-02	1.32200E-03	4.64707E-03	1.39376E-04
5.00000E-02	6.25000E-02	1.81500E-03	6.46207E-03	2.41469E-04
6.25000E-02	7.75000E-02	2.43300E-03	8.89507E-03	4.11779E-04
7.75000E-02	9.25000E-02	2.65350E-03	1.15486E-02	6.37327E-04
9.25000E-02	1.15000E-01	4.27500E-03	1.58236E-02	1.08086E-03
1.15000E-01	1.45000E-01	6.36900E-03	2.21926E-02	1.90883E-03
1.45000E-01	1.80000E-01	8.07800E-03	3.02706E-02	3.22150E-03
1.80000E-01	2.25000E-01	1.13040E-02	4.15746E-02	5.51056E-03
2.25000E-01	2.75000E-01	1.35800E-02	5.51546E-02	8.90556E-03
2.75000E-01	3.35000E-01	1.72620E-02	7.24166E-02	1.41705E-02
3.35000E-01	4.15000E-01	2.43920E-02	9.68086E-02	2.33175E-02
4.15000E-01	4.80000E-01	2.08065E-02	1.17615E-01	3.26284E-02
4.80000E-01	5.50000E-01	2.27360E-02	1.40351E-01	4.43374E-02
5.50000E-01	6.50000E-01	3.32900E-02	1.73641E-01	6.43114E-02
6.50000E-01	7.75000E-01	4.20375E-02	2.15679E-01	9.42631E-02
7.75000E-01	9.25000E-01	5.02800E-02	2.65959E-01	1.37001E-01
9.25000E-01	1.10000E+00	5.75575E-02	3.23516E-01	1.95278E-01
1.10000E+00	1.35000E+00	7.88000E-02	4.02316E-01	2.91808E-01
1.35000E+00	1.75000E+00	1.15000E-01	5.17316E-01	4.70058E-01
1.75000E+00	2.20000E+00	1.05840E-01	6.23156E-01	6.79092E-01
2.20000E+00	2.55000E+00	6.82500E-02	6.91406E-01	8.41186E-01
2.55000E+00	2.85000E+00	5.03100E-02	7.41716E-01	9.77023E-01
2.85000E+00	3.15000E+00	4.29300E-02	7.84646E-01	1.10581E+00
3.15000E+00	3.40000E+00	3.03250E-02	8.14971E-01	1.20513E+00
3.40000E+00	3.60000E+00	2.16400E-02	8.36611E-01	1.28087E+00
3.60000E+00	3.80000E+00	1.92720E-02	8.55883E-01	1.35217E+00
3.80000E+00	4.00000E+00	1.71180E-02	8.73001E-01	1.41893E+00
4.00000E+00	4.20000E+00	1.51760E-02	8.88177E-01	1.48116E+00
4.20000E+00	4.40000E+00	1.34320E-02	9.01609E-01	1.53891E+00
4.40000E+00	4.60000E+00	1.18740E-02	9.13483E-01	1.59235E+00
4.60000E+00	4.80000E+00	1.04840E-02	9.23967E-01	1.64162E+00
4.80000E+00	5.00000E+00	9.25000E-03	9.33217E-01	1.68695E+00

5.00000E+00	5.20000E+00	8.15600E-03	9.41373E-01	1.72854E+00
5.20000E+00	5.40000E+00	7.18400E-03	9.48557E-01	1.76662E+00
5.40000E+00	5.60000E+00	6.32600E-03	9.54883E-01	1.80141E+00
5.60000E+00	5.80000E+00	5.56400E-03	9.60447E-01	1.83312E+00
5.80000E+00	6.00000E+00	4.89200E-03	9.65339E-01	1.86199E+00
6.00000E+00	6.20000E+00	4.29800E-03	9.69637E-01	1.88821E+00
6.20000E+00	6.40000E+00	3.77400E-03	9.73411E-01	1.91198E+00
6.40000E+00	6.60000E+00	3.31000E-03	9.76721E-01	1.93350E+00
6.60000E+00	6.80000E+00	2.90200E-03	9.79623E-01	1.95294E+00
6.80000E+00	7.00000E+00	2.54400E-03	9.82167E-01	1.97049E+00
7.00000E+00	7.20000E+00	2.22800E-03	9.84395E-01	1.98631E+00
7.20000E+00	7.40000E+00	1.95100E-03	9.86346E-01	2.00055E+00
7.40000E+00	7.60000E+00	1.70800E-03	9.88054E-01	2.01336E+00
7.60000E+00	7.80000E+00	1.49500E-03	9.89549E-01	2.02488E+00
7.80000E+00	8.00000E+00	1.30820E-03	9.90857E-01	2.03521E+00
8.00000E+00	8.20000E+00	1.14500E-03	9.92002E-01	2.04449E+00
8.20000E+00	8.40000E+00	1.00220E-03	9.93004E-01	2.05280E+00
8.40000E+00	8.60000E+00	8.77000E-04	9.93881E-01	2.06026E+00
8.60000E+00	8.80000E+00	7.67600E-04	9.94649E-01	2.06694E+00
8.80000E+00	9.00000E+00	6.72000E-04	9.95321E-01	2.07292E+00
9.00000E+00	9.20000E+00	5.88000E-04	9.95909E-01	2.07827E+00
9.20000E+00	9.40000E+00	5.14600E-04	9.96424E-01	2.08305E+00
9.40000E+00	9.60000E+00	4.50400E-04	9.96874E-01	2.08733E+00
9.60000E+00	9.80000E+00	3.94000E-04	9.97268E-01	2.09115E+00
9.80000E+00	1.00000E+01	3.44600E-04	9.97613E-01	2.09457E+00
1.00000E+01	1.02000E+01	3.01200E-04	9.97914E-01	2.09761E+00
1.02000E+01	1.04000E+01	2.63400E-04	9.98177E-01	2.10032E+00
1.04000E+01	1.06000E+01	2.30200E-04	9.98407E-01	2.10274E+00
1.06000E+01	1.08000E+01	2.01400E-04	9.98609E-01	2.10489E+00
1.08000E+01	1.10000E+01	1.76040E-04	9.98785E-01	2.10681E+00
1.10000E+01	1.12000E+01	1.53940E-04	9.98939E-01	2.10852E+00
1.12000E+01	1.14000E+01	1.34580E-04	9.99073E-01	2.11004E+00
1.14000E+01	1.16000E+01	1.17660E-04	9.99191E-01	2.11139E+00
1.16000E+01	1.18000E+01	1.02840E-04	9.99294E-01	2.11260E+00
1.18000E+01	1.20000E+01	8.98800E-05	9.99384E-01	2.11367E+00
1.20000E+01	1.22000E+01	7.85400E-05	9.99462E-01	2.11462E+00
1.22000E+01	1.24000E+01	6.86000E-05	9.99531E-01	2.11546E+00
1.24000E+01	1.26000E+01	5.99200E-05	9.99591E-01	2.11621E+00
1.26000E+01	1.28000E+01	5.23400E-05	9.99643E-01	2.11687E+00
1.28000E+01	1.30000E+01	4.56800E-05	9.99689E-01	2.11746E+00
1.30000E+01	1.31500E+01	2.99100E-05	9.99719E-01	2.11786E+00
1.31500E+01	1.33000E+01	2.79300E-05	9.99747E-01	2.11822E+00
1.33000E+01	1.34500E+01	2.43750E-05	9.99771E-01	2.11855E+00
1.34500E+01	1.36000E+01	2.27550E-05	9.99794E-01	2.11886E+00
1.36000E+01	1.38000E+01	2.64600E-05	9.99820E-01	2.11922E+00
1.38000E+01	1.40000E+01	2.30800E-05	9.99843E-01	2.11954E+00
1.40000E+01	1.41500E+01	1.51050E-05	9.99859E-01	2.11975E+00
1.41500E+01	1.43000E+01	1.40985E-05	9.99873E-01	2.11995E+00
1.43000E+01	1.45000E+01	1.63900E-05	9.99889E-01	2.12019E+00
1.45000E+01	1.49500E+01	3.21525E-05	9.99921E-01	2.12066E+00
1.49500E+01	1.56500E+01	3.09400E-05	9.99952E-01	2.12114E+00
1.56500E+01	1.63500E+01	1.91310E-05	9.99971E-01	2.12144E+00
1.63500E+01	1.70500E+01	1.18160E-05	9.99983E-01	2.12164E+00
1.70500E+01	1.77500E+01	7.29400E-06	9.99990E-01	2.12177E+00
1.77500E+01	1.84500E+01	4.49540E-06	9.99995E-01	2.12185E+00
1.84500E+01	1.91500E+01	2.76500E-06	9.99998E-01	2.12190E+00
1.91500E+01	1.97500E+01	1.45620E-06	9.99999E-01	2.12193E+00
1.97500E+01	2.02500E+01	8.56500E-07	1.00000E+00	2.12195E+00

.212195E+01

xcfen6 cf spectrum, endfbvi tabulation Carlson 3-24-93

LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX	LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX
1.00000E-10	4.64711E-03	1.00000E+00	3.00000E+00	5.09081E-02	2.35931E-01
5.00000E-02	8.27621E-03	9.95353E-01	3.40000E+00	3.15581E-02	1.85023E-01
1.00000E-01	2.22634E-02	9.87077E-01	3.70000E+00	4.16485E-02	1.53465E-01
2.00000E-01	1.30949E-02	9.64813E-01	4.20000E+00	2.53062E-02	1.11816E-01
2.50000E-01	1.39216E-02	9.51718E-01	4.60000E+00	1.97342E-02	8.65099E-02
3.00000E-01	2.99897E-02	9.37797E-01	5.00000E+00	1.86042E-02	6.67758E-02
4.00000E-01	3.18388E-02	9.07807E-01	5.50000E+00	1.35181E-02	4.81716E-02
5.00000E-01	3.29096E-02	8.75968E-01	6.00000E+00	9.78146E-03	3.46536E-02
6.00000E-01	3.35515E-02	8.43059E-01	6.50000E+00	7.04667E-03	2.48721E-02
7.00000E-01	3.36029E-02	8.09507E-01	7.00000E+00	5.06149E-03	1.78254E-02
8.00000E-01	6.66839E-02	7.75904E-01	7.50000E+00	3.62878E-03	1.27639E-02
1.00000E+00	6.48309E-02	7.09220E-01	8.00000E+00	2.60036E-03	9.13516E-03
1.20000E+00	6.22171E-02	6.44389E-01	8.50000E+00	1.86348E-03	6.53480E-03
1.40000E+00	2.99653E-02	5.82172E-01	9.00000E+00	1.33534E-03	4.67132E-03
1.50000E+00	2.86760E-02	5.52207E-01	9.50000E+00	9.56280E-04	3.33599E-03
1.60000E+00	5.37621E-02	5.23531E-01	1.00000E+01	1.17225E-03	2.37971E-03
1.80000E+00	4.85820E-02	4.69769E-01	1.10000E+01	5.98905E-04	1.20746E-03
2.00000E+00	4.43478E-02	4.21187E-01	1.20000E+01	3.05082E-04	6.08552E-04
2.20000E+00	2.06286E-02	3.76839E-01	1.30000E+01	1.54511E-04	3.03470E-04
2.30000E+00	1.96867E-02	3.56211E-01	1.40000E+01	1.19435E-04	1.48958E-04
2.40000E+00	3.68521E-02	3.36524E-01	1.60000E+01	2.95231E-05	2.95231E-05

TOTAL FLUX 9.99992E-01

SPECTRUM, cf spectrum, endfbvi tabulation CarDESIGNATION, xcfen6

CROSS SECTIONS, ENTRY DATE, 3-24-93

FLUX GREATER THAN 1 MEV, 0.709 REVISED,

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
SPECTRUM CHECK	1.000E+00	1.000E+00	9.500E-01	1.686E+00	2.564E-01	5.444E+00
RECP VEL 1/V	1.108E-01	1.062E-01	9.913E-01	1.010E+00	7.628E-02	4.219E+00
FISSIONABLE MATERIALS						
PU239(N,F)FP	1.794E+00	1.809E+00	9.421E-01	1.756E+00	2.847E-01	5.605E+00
U235(N,F)FP	1.237E+00	1.223E+00	9.610E-01	1.687E+00	2.149E-01	5.684E+00
U233(N,F)FP	1.904E+00	1.887E+00	9.586E-01	1.625E+00	2.244E-01	5.428E+00
NP237(N,F)F.	1.360E+00	1.593E+00	8.109E-01	2.057E+00	6.960E-01	6.092E+00
U238(N,F)FP	3.151E-01	5.395E-01	5.548E-01	2.774E+00	1.491E+00	7.168E+00
TH232(N,F)F.	7.829E-02	1.354E-01	5.495E-01	2.990E+00	1.510E+00	7.647E+00
PU240(N,F)FP	1.364E+00	1.601E+00	8.093E-01	2.059E+00	7.006E-01	6.034E+00
PU241(N,F)FP	1.597E+00	1.575E+00	9.630E-01	1.634E+00	2.073E-01	5.496E+00
AM241(N,F)FP	1.485E+00	1.921E+00	7.347E-01	2.233E+00	9.230E-01	6.137E+00
U238(N,G)U23	6.854E-02	6.565E-02	9.918E-01	9.085E-01	7.360E-02	2.809E+00
TH232(N,G)TH	8.978E-02	8.630E-02	9.884E-01	9.306E-01	9.295E-02	2.927E+00
CAPTURE REACTIONS						
NA23(N,G)NA2	2.712E-04	2.589E-04	9.949E-01	9.652E-01	5.314E-02	4.683E+00
SC45(N,G)SC4	5.304E-03	5.053E-03	9.973E-01	6.550E-01	3.440E-02	2.862E+00
FE58(N,G)FE5	1.668E-03	1.592E-03	9.955E-01	1.075E+00	4.898E-02	4.786E+00
CO59(N,G)CO6	6.068E-03	5.795E-03	9.948E-01	1.084E+00	5.394E-02	4.004E+00
CU63(N,G)CU6	9.693E-03	9.257E-03	9.948E-01	9.893E-01	5.420E-02	4.008E+00
IN115(N,G)IN	1.219E-01	1.174E-01	9.866E-01	1.130E+00	1.024E-01	2.954E+00
AU197(N,G)AU	7.632E-02	7.291E-02	9.944E-01	7.606E-01	5.665E-02	2.981E+00

SPECTRUM, cf spectrum, endfbvi tabulation CarDESIGNATION, xcfen6

CROSS SECTIONS, ENDF/BVC DOSIMETRY FILE ENTRY DATE, 3-24-93

FLUX GREATER THAN 1 MEV, 0.709 REVISED,

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
HELIUM PRODUCTION						
B10(N,A)LI7	4.888E-01	4.677E-01	9.928E-01	1.452E+00	6.703E-02	5.547E+00
LI6(N,A)H3	4.580E-01	4.477E-01	9.717E-01	1.609E+00	1.716E-01	6.005E+00
THRESHOLD REACTIONS						
IN115(N,N)IN	1.831E-01	2.693E-01	6.460E-01	2.698E+00	1.195E+00	6.181E+00
TI47(N,P)SC4	2.400E-02	5.147E-02	4.429E-01	3.878E+00	1.909E+00	7.968E+00
S32(N,P)P32	7.572E-02	2.047E-01	3.514E-01	4.094E+00	2.325E+00	7.839E+00
NI58(N,P)CO5	1.132E-01	2.809E-01	3.828E-01	4.176E+00	2.172E+00	7.916E+00
FE54(N,P)MN5	8.772E-02	2.458E-01	3.391E-01	4.261E+00	2.387E+00	7.973E+00
TI46(N,P)SC4	1.316E-02	8.711E-02	1.436E-01	5.887E+00	3.806E+00	9.909E+00
AL27(N,P)MG2	5.024E-03	2.737E-02	1.744E-01	5.964E+00	3.496E+00	9.868E+00
NI60(N,P)CO6	3.341E-03	4.550E-02	6.976E-02	7.260E+00	4.933E+00	1.100E+01
FE56(N,P)MN5	1.374E-03	2.800E-02	4.662E-02	7.571E+00	5.551E+00	1.191E+01
CU63(N,A)CO5	7.383E-04	9.652E-03	7.267E-02	7.725E+00	4.870E+00	1.159E+01
AL27(N,A)NA2	1.034E-03	4.134E-02	2.376E-02	8.674E+00	6.570E+00	1.251E+01
TI48(N,P)SC4	3.998E-04	1.116E-02	3.403E-02	8.447E+00	6.028E+00	1.290E+01
MN55(N,2N)MN	4.572E-04	4.086E-01	1.063E-03	1.290E+01	1.119E+01	1.611E+01
MISCELLANEOUS REACTIONS						
RH(N,N')	7.066E-01	8.502E-01	7.896E-01	2.367E+00	7.593E-01	5.902E+00
NB(N,N')93M	1.488E-01	1.961E-01	7.207E-01	2.668E+00	9.651E-01	6.021E+00
DPA(E-693)	8.964E+02	1.036E+03	8.223E-01	2.645E+00	6.620E-01	6.747E+00

logout

Sample Output from Problem 7

```
Wed Nov 16 08:15:33 EST 1994
You are in the UNICOS C-shell.


-   -   -   -   -   -   Cray Y-MP4E/232 (UNICOS 8.0.2.4)   -   -   -   -   -   -

UNICOS UPGRADE -- UNICOS has been upgraded from level 8.0.2.2 to
  the corrective code level 8.0.2.4. (11/8/94)

NAG UPGRADE - Effective November 7, 1994, NAG Mark 16 will replace NAG
  Mark 15 as the NAG Fortran Library on granta. For Mark 16, 126 new primary
  routines have been introduced, and 34 deleted.  For more information,
  please type:  hp nag

COMPILER AND LIBRARY UPGRADE -- The Cray compilers cf77 and f90
  were upgraded to levels 6.0.3.24 and 1.0.1.8 on Friday November
  4.  CrayLibs and CrayTools were upgraded to levels 1.1.0.1 and
  1.2.1.0.  These were code fix releases and involved no new user
  features.

-   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.490s,  Wallclock: 0.554s,  44.2% of 2-CPU Machine
 HWM mem: 203680, HWM stack: 26061, Stack overflows: 0
      1CONST
```

XCFmax Maxwellian CF FISSION SPECTRUM,T=1.41 1-10-94

LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX	LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX
1.00000E-10	4.86668E-03	1.00000E+00	3.00000E+00	5.01962E-02	2.38113E-01
5.00000E-02	8.61228E-03	9.95133E-01	3.40000E+00	3.09707E-02	1.87917E-01
1.00000E-01	2.30871E-02	9.86521E-01	3.70000E+00	4.11678E-02	1.56946E-01
2.00000E-01	1.35247E-02	9.63434E-01	4.20000E+00	2.52942E-02	1.15778E-01
2.50000E-01	1.43617E-02	9.49909E-01	4.60000E+00	1.99354E-02	9.04842E-02
3.00000E-01	3.07882E-02	9.35548E-01	5.00000E+00	1.90100E-02	7.05488E-02
4.00000E-01	3.25538E-02	9.04759E-01	5.50000E+00	1.39920E-02	5.15388E-02
5.00000E-01	3.35515E-02	8.72206E-01	6.00000E+00	1.02593E-02	3.75469E-02
6.00000E-01	3.40492E-02	8.38654E-01	6.50000E+00	7.49815E-03	2.72876E-02
7.00000E-01	3.39945E-02	8.04605E-01	7.00000E+00	5.46500E-03	1.97895E-02
8.00000E-01	6.70656E-02	7.70610E-01	7.50000E+00	3.97363E-03	1.43245E-02
1.00000E+00	6.44367E-02	7.03545E-01	8.00000E+00	2.88320E-03	1.03508E-02
1.20000E+00	6.085[illegible]4E-02	6.39108E-01	8.50000E+00	2.08814E-03	7.46763E-03
1.40000E+00	2.892[illegible]9E-02	5.78249E-01	9.00000E+00	1.50984E-03	5.37949E-03
1.50000E+00	2.78702E-02	5.49326E-01	9.50000E+00	1.09010E-03	3.86965E-03
1.60000E+00	5.25232E-02	5.21456E-01	1.00000E+01	1.35208E-03	2.77955E-03
1.80000E+00	4.82359E-02	4.68932E-01	1.10000E+01	6.99900E-04	1.42748E-03
2.00000E+00	4.40518E-02	4.20697E-01	1.20000E+01	3.60915E-04	7.27578E-04
2.20000E+00	2.05109E-02	3.76645E-01	1.30000E+01	1.85509E-04	3.66663E-04
2.30000E+00	1.95364E-02	3.56134E-01	1.40000E+01	1.43708E-04	1.81154E-04
2.40000E+00	3.62685E-02	3.36597E-01	1.60000E+01	3.74462E-05	3.74462E-05

TOTAL FLUX 1.00052E+00

SPECTRUM, Maxwellian CF FISSION SPECTRUM,T=1.0 DESIGNATION,XCFmax

CROSS SECTIONS, ENTRY DATE, -10-94

FLUX GREATER THAN 1 MEV, 0.704 REVISED,

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
SPECTRUM CHECK	1.000E+00	1.000E+00	9.500E-01	1.680E+00	2.498E-01	5.549E+00
RECP VEL 1/V	1.116E-01	1.069E-01	9.915E-01	9.842E-01	7.283E-02	4.255E+00
FISSIONABLE MATERIALS						
PU239(N,F)FP	1.793E+00	1.808E+00	9.422E-01	1.754E+00	2.772E-01	5.744E+00
U235(N,F)FP	1.238E+00	1.224E+00	9.613E-01	1.682E+00	2.081E-01	5.853E+00
U233(N,F)FP	1.906E+00	1.889E+00	9.587E-01	1.617E+00	2.180E-01	5.567E+00
NP237(N,F)F.	1.354E+00	1.593E+00	8.075E-01	2.065E+00	6.917E-01	6.269E+00
U238(N,F)FP	3.145E-01	5.427E-01	5.505E-01	2.799E+00	1.496E+00	7.346E+00
TH232(N,F)F.	7.845E-02	1.366E-01	5.454E-01	3.030E+00	1.514E+00	7.807E+00
PU240(N,F)FP	1.358E+00	1.600E+00	8.061E-01	2.067E+00	6.956E-01	6.210E+00
PU241(N,F)FP	1.598E+00	1.576E+00	9.632E-01	1.628E+00	2.009E-01	5.636E+00
AM241(N,F)FP	1.476E+00	1.921E+00	7.302E-01	2.245E+00	9.198E-01	6.313E+00
U238(N,G)U23	6.893E-02	6.601E-02	9.920E-01	8.933E-01	6.982E-02	2.796E+00
TH232(N,G)TH	9.020E-02	8.666E-02	9.887E-01	9.134E-01	8.843E-02	2.917E+00
CAPTURE REACTIONS						
NA23(N,G)NA2	2.740E-04	2.617E-04	9.948E-01	9.323E-01	5.262E-02	4.746E+00
SC45(N,G)SC4	5.382E-03	5.126E-03	9.975E-01	6.349E-01	3.210E-02	2.847E+00
FE58(N,G)FE5	1.680E-03	1.603E-03	9.959E-01	1.042E+00	4.443E-02	4.841E+00
CO59(N,G)CO6	6.097E-03	5.821E-03	9.950E-01	1.065E+00	5.083E-02	4.026E+00
CU63(N,G)CU6	9.761E-03	9.319E-03	9.951E-01	9.662E-01	5.046E-02	4.036E+00
IN115(N,G)IN	1.220E-01	1.174E-01	9.870E-01	1.111E+00	9.753E-02	2.946E+00
AU197(N,G)AU	7.707E-02	7.361E-02	9.946E-01	7.361E-01	5.332E-02	2.966E+00

SPECTRUM, Maxwellian CF FISSION SPECTRUM,T=1.DESIGNATION,XCFmax

CROSS SECTIONS, ENDF/BVC DOSIMETRY FILE ENTRY DATE, -10-94

FLUX GREATER THAN 1 MEV, 0.704 REVISED,

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
HELIUM PRODUCTION						
B10(N,A)LI7	4.939E-01	4.725E-01	9.930E-01	1.408E+00	6.411E-02	5.623E+00
LI6(N,A)H3	4.627E-01	4.526E-01	9.712E-01	1.576E+00	1.690E-01	6.101E+00
THRESHOLD REACTIONS						
IN115(N,N)IN	1.820E-01	2.696E-01	6.414E-01	2.712E+00	1.193E+00	6.299E+00
TI47(N,P)SC4	2.422E-02	5.231E-02	4.398E-01	3.932E+00	1.919E+00	8.160E+00
S32(N,P)P32	7.646E-02	2.072E-01	3.506E-01	4.132E+00	2.328E+00	8.024E+00
NI58(N,P)CO5	1.146E-01	2.865E-01	3.799E-01	4.233E+00	2.185E+00	8.081E+00
FE54(N,P)MN5	8.888E-02	2.504E-01	3.372E-01	4.321E+00	2.397E+00	8.140E+00
TI46(N,P)SC4	1.381E-02	9.045E-02	1.451E-01	5.972E+00	3.830E+00	1.007E+01
AL27(N,P)MG2	5.275E-03	2.858E-02	1.753E-01	6.056E+00	3.516E+00	1.001E+01
NI60(N,P)CO6	3.621E-03	4.772E-02	7.208E-02	7.346E+00	4.966E+00	1.115E+01
FE56(N,P)MN5	1.504E-03	2.917E-02	4.897E-02	7.651E+00	5.581E+00	1.204E+01
CU63(N,A)CO5	8.070E-04	1.039E-02	7.376E-02	7.845E+00	4.929E+00	1.169E+01
AL27(N,A)NA2	1.157E-03	4.293E-02	2.561E-02	8.734E+00	6.599E+00	1.261E+01
TI48(N,P)SC4	4.455E-04	1.172E-02	3.611E-02	8.538E+00	6.062E+00	1.302E+01
MN55(N,2N)MN	5.453E-04	4.140E-01	1.251E-03	1.293E+01	1.120E+01	1.618E+01
MISCELLANEOUS REACTIONS						
RH(N,N')	7.031E-01	8.494E-01	7.864E-01	2.375E+00	7.536E-01	5.997E+00
NB(N,N')93M	1.479E-01	1.959E-01	7.172E-01	2.679E+00	9.587E-01	6.138E+00
DPA(E-693)	8.963E+02	1.036E+03	8.220E-01	2.664E+00	6.490E-01	6.917E+00

logout

Sample Output from Problem 8

```
Wed Nov 16 08:19:34 EST 1994
You are in the UNICOS C-shell.

- - - - - - Cray Y-MP4E/232 (UNICOS 8.0.2.4) - - - - - -

UNICOS UPGRADE -- UNICOS has been upgraded from level 8.0.2.2 to
  the corrective code level 8.0.2.4. (11/8/94)

NAG UPGRADE - Effective November 7, 1994, NAG Mark 16 will replace NAG
  Mark 15 as the NAG Fortran Library on granta. For Mark 16, 126 new primary
  routines have been introduced, and 34 deleted.  For more information,
  please type:  hp nag

COMPILER AND LIBRARY UPGRADE -- The Cray compilers cf77 and f90
  were upgraded to levels 6.0.3.24 and 1.0.1.8 on Friday November
  4.  CrayLibs and CrayTools were upgraded to levels 1.1.0.1 and
  1.2.1.0.  These were code fix releases and involved no new user
  features.

- - - - - - - - - - - - - - - - - - - -

news: survey f90 unicos80 tools.news libs.news CF77.news CC4.news

 STOP executed at line 692 in Fortran routine 'DETAN'
 CP: 0.491s,  Wallclock: 0.555s,  44.3% of 2-CPU Machine
 HWM mem: 203680, HWM stack: 26061, Stack overflows: 0
      1CONST
```

XU5EN6 EN6 U-235 FIS SPC,B=1.012,Q=.549 6-20-90

LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX	LOWER ENERGY BOUNDARY (MEV)	GROUP FLUX	CUMULATIVE GROUP FLUX
1.00000E-10	4.81972E-03	1.00000E+00	3.00000E+00	5.02752E-02	2.18729E-01
5.00000E-02	8.55457E-03	9.95180E-01	3.40000E+00	3.05394E-02	1.68454E-01
1.00000E-01	2.30381E-02	9.86626E-01	3.70000E+00	3.97805E-02	1.37915E-01
2.00000E-01	1.35528E-02	9.63588E-01	4.20000E+00	2.37994E-02	9.81341E-02
2.50000E-01	1.44294E-02	9.50035E-01	4.60000E+00	1.82717E-02	7.43346E-02
3.00000E-01	3.10517E-02	9.35605E-01	5.00000E+00	1.68747E-02	5.60629E-02
4.00000E-01	3.29845E-02	9.04554E-01	5.50000E+00	1.19443E-02	3.91882E-02
5.00000E-01	3.41370E-02	8.71569E-01	6.00000E+00	8.39604E-03	2.72439E-02
6.00000E-01	3.47734E-02	8.37432E-01	6.50000E+00	5.86600E-03	1.88479E-02
7.00000E-01	3.48293E-02	8.02659E-01	7.00000E+00	4.07624E-03	1.29819E-02
8.00000E-01	6.89956E-02	7.67829E-01	7.50000E+00	2.81883E-03	8.90562E-03
1.00000E+00	6.65670E-02	6.98834E-01	8.00000E+00	1.94078E-03	6.08678E-03
1.20000E+00	6.30390E-02	6.32267E-01	8.50000E+00	1.33091E-03	4.14601E-03
1.40000E+00	2.99924E-02	5.69228E-01	9.00000E+00	9.09373E-04	2.81509E-03
1.50000E+00	2.89095E-02	5.39235E-01	9.50000E+00	6.19268E-04	1.90572E-03
1.60000E+00	5.44720E-02	5.10326E-01	1.00000E+01	7.04996E-04	1.28645E-03
1.80000E+00	4.99629E-02	4.55854E-01	1.10000E+01	3.21526E-04	5.81457E-04
2.00000E+00	4.55191E-02	4.05891E-01	1.20000E+01	1.45217E-04	2.59931E-04
2.20000E+00	2.11408E-02	3.60372E-01	1.30000E+01	6.50275E-05	1.14714E-04
2.30000E+00	2.00957E-02	3.39231E-01	1.40000E+01	4.16517E-05	4.96861E-05
2.40000E+00	3.71766E-02	3.19135E-01	1.60000E+01	8.03440E-06	8.03440E-06

TOTAL FLUX 9.99987E-01

SPECTRUM, EN6 U-235 FIS SPC,B=1.012,Q=.549 DESIGNATION, XU5EN6

CROSS SECTIONS, ENTRY DATE, 6-20-90

FLUX GREATER THAN 1 MEV, 0.699 REVISED,

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
SPECTRUM CHECK	1.000E+00	1.000E+00	9.500E-01	1.637E+00	2.502E-01	5.161E+00
RECP VEL 1/V	1.126E-01	1.079E-01	9.914E-01	9.822E-01	7.423E-02	4.042E+00
FISSIONABLE MATERIALS						
PU239(N,F)FP	1.791E+00	1.806E+00	9.423E-01	1.709E+00	2.773E-01	5.250E+00
U235(N,F)FP	1.236E+00	1.221E+00	9.614E-01	1.638E+00	2.085E-01	5.259E+00
U233(N,F)FP	1.907E+00	1.890E+00	9.586E-01	1.579E+00	2.187E-01	5.070E+00
NP237(N,F)F.	1.347E+00	1.585E+00	8.071E-01	2.000E+00	6.874E-01	5.661E+00
U238(N,F)FP	3.052E-01	5.328E-01	5.441E-01	2.689E+00	1.484E+00	6.738E+00
TH232(N,F)F.	7.504E-02	1.324E-01	5.383E-01	2.878E+00	1.503E+00	7.263E+00
PU240(N,F)FP	1.352E+00	1.594E+00	8.057E-01	2.006E+00	6.914E-01	5.602E+00
PU241(N,F)FP	1.598E+00	1.577E+00	9.632E-01	1.591E+00	2.016E-01	5.127E+00
AM241(N,F)FP	1.465E+00	1.910E+00	7.286E-01	2.174E+00	9.132E-01	5.732E+00
U238(N,G)U23	7.026E-02	6.730E-02	9.917E-01	8.994E-01	7.208E-02	2.750E+00
TH232(N,G)TH	9.195E-02	8.839E-02	9.883E-01	9.194E-01	9.127E-02	2.865E+00
CAPTURE REACTIONS						
NA23(N,G)NA2	2.750E-04	2.626E-04	9.948E-01	9.244E-01	5.274E-02	4.429E+00
SC45(N,G)SC4	5.447E-03	5.189E-03	9.974E-01	6.440E-01	3.293E-02	2.756E+00
FE58(N,G)FE5	1.687E-03	1.610E-03	9.959E-01	1.027E+00	4.498E-02	4.574E+00
CO59(N,G)CO6	6.174E-03	5.896E-03	9.949E-01	1.065E+00	5.221E-02	3.864E+00
CU63(N,G)CU6	9.868E-03	9.423E-03	9.949E-01	9.667E-01	5.189E-02	3.842E+00
IN115(N,G)IN	1.246E-01	1.200E-01	9.865E-01	1.117E+00	1.006E-01	2.911E+00
AU197(N,G)AU	7.827E-02	7.477E-02	9.945E-01	7.469E-01	5.482E-02	2.913E+00

SPECTRUM, EN6 U-235 FIS SPC,B=1.012,Q=.549 DESIGNATION, XU5EN6

CROSS SECTIONS, ENDF/BVC DOSIMETRY FILE ENTRY DATE, 6-20-90

FLUX GREATER THAN 1 MEV, 0.699 REVISED,

DETECTOR REACTION	CROSS SECTION (BARNS) SIG(0.4EV)	SIG(P=95)	SPECTRUM FRACTION	RESPONSE ENERGIES (MEV) MEDIAN P=50	P=95	P=05
HELIUM PRODUCTION						
B10(N,A)LI7	4.906E-01	4.694E-01	9.930E-01	1.349E+00	6.430E-02	5.295E+00
LI6(N,A)H3	4.545E-01	4.444E-01	9.716E-01	1.463E+00	1.679E-01	5.721E+00
THRESHOLD REACTIONS						
IN115(N,N)IN	1.793E-01	2.663E-01	6.394E-01	2.637E+00	1.178E+00	5.915E+00
TI47(N,P)SC4	2.246E-02	4.894E-02	4.360E-01	3.753E+00	1.878E+00	7.477E+00
S32(N,P)P32	7.050E-02	1.980E-01	3.382E-01	4.009E+00	2.305E+00	7.390E+00
NI58(N,P)CO5	1.050E-01	2.650E-01	3.764E-01	4.056E+00	2.128E+00	7.506E+00
FE54(N,P)MN5	8.102E-02	2.330E-01	3.303E-01	4.139E+00	2.344E+00	7.555E+00
TI46(N,P)SC4	1.117E-02	7.980E-02	1.330E-01	5.697E+00	3.755E+00	9.317E+00
AL27(N,P)MG2	4.263E-03	2.497E-02	1.622E-01	5.757E+00	3.458E+00	9.353E+00
NI60(N,P)CO6	2.608E-03	3.991E-02	6.208E-02	7.016E+00	4.857E+00	1.038E+01
FE56(N,P)MN5	1.036E-03	2.463E-02	3.997E-02	7.321E+00	5.473E+00	1.116E+01
CU63(N,A)CO5	5.582E-04	7.794E-03	6.804E-02	7.352E+00	4.727E+00	1.105E+01
AL27(N,A)NA2	7.194E-04	3.579E-02	1.910E-02	8.414E+00	6.483E+00	1.185E+01
TI48(N,P)SC4	2.817E-04	9.308E-03	2.875E-02	8.083E+00	5.927E+00	1.211E+01
MN55(N,2N)MN	2.011E-04	3.581E-01	5.336E-04	1.265E+01	1.111E+01	1.560E+01
MISCELLANEOUS REACTIONS						
RH(N,N')	6.974E-01	8.428E-01	7.861E-01	2.299E+00	7.475E-01	5.664E+00
NB(N,N')93M	1.460E-01	1.934E-01	7.172E-01	2.602E+00	9.462E-01	5.759E+00
DPA(E-693)	8.736E+02	1.003E+03	8.277E-01	2.554E+00	6.281E-01	6.343E+00

logout